Chapter 6.7 ESTUARY AND COASTAL PROGRAM INITIATIVES AND ASSESSMENT

The Commonwealth of Virginia has 120 miles of Atlantic Ocean coastline and approximately 2, 300 square miles of estuary. The estuarine waters of Chesapeake Bay and its tidal tributaries are valued for their commercial fishing, wildlife, sporting, and recreational opportunities, as well as its commercial values in shipping and industry. In the late 1970's, adverse trends in water quality and living resources were noted and prompted creation of the Federal-Interstate Chesapeake Bay Program (CBP).

Through participation in the CBP and implementation of special state initiatives, Virginia maintains a firm commitment to rehabilitate and wisely manage its estuarine resources. This chapter provides an overview of the state's initiatives intended to restore and preserve the Chesapeake Bay and its tidal tributaries as well as the results of the 2008 assessment of designated uses.

Federal - Interstate Chesapeake Bay Program

In 1983, Virginia, Maryland, Pennsylvania, the District of Columbia, the Environmental Protection Agency, and the Chesapeake Bay Commission signed the first Chesapeake Bay Agreement, formally initiating the restoration and protection of the Bay using a cooperative Chesapeake Bay Program approach. This approach established specific mechanisms for its coordination among the Program participants. Over the past two decades several updated and new Bay Agreements, Executive Council Directives and pollution reduction strategies have been adopted by the Bay Program partners, generally refining and making the goals and objectives of the restoration effort more specific, establishing timelines and measurable outcomes to gauge progress.

On June 28, 2000, the Chesapeake Executive Council signed Chesapeake 2000 – a new and far-reaching agreement that has been guiding Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission, and the U.S. Environmental Protection Agency (EPA) in their combined efforts to restore and protect the Chesapeake Bay. Chesapeake 2000 outlines over 100 commitments in five program areas – Living Resource Protection and Restoration, Vital Habitat Protection and Restoration, Water Quality Protection and Restoration, Sound Land Use, and Stewardship and Community Engagement – detailing protection and restoration goals critical to the health of the Bay watershed. From pledges to increase riparian forest buffers, preserve additional tracts of land, restore oyster populations and protect wetlands, Chesapeake 2000 strives toward improving water quality as the most critical element in the overall protection and restoration of the Bay and its tributaries.

At the same time Bay Program partners were developing the new Bay Agreement, the Chesapeake Bay and many of its tidal tributaries were placed on the "impaired waters" list. This action is normally followed by the development of a "total maximum daily load" (TMDL) through a regulatory process. Chesapeake 2000 sought to avoid regulatory approaches by achieving water quality improvements prior to the timeframe when a Baywide TMDL would need to be established. To accomplish this goal, the Chesapeake Bay Program developed a new process for setting and achieving nutrient and sediment load reductions necessary to restore Bay water quality. In this process Bay Program partners built on previous nitrogen and phosphorus reduction efforts, but instead of measuring improvement against broad 1997 40% reduction goals, they established specific water quality conditions to be met. This new process incorporated elements traditionally found in the regulatory TMDL process, such as water quality criteria and load allocations, but also was developed and applied through a cooperative process involving the six watershed states, the District of Columbia, local governments and involved citizens. For the first time, Delaware, New York and West Virginia formally partnered with EPA, the Bay states and the District to improve water quality watershed-wide and have developed nutrient and sediment reduction Tributary Strategies for their portions of the watershed.

In Virginia, the Department of Environmental Quality (DEQ) has primary responsibility for water quality standards, the TMDL program, point source discharge issues, bringing together programs in the areas of surface and groundwater protection, waste management, and air pollution control. The Department of Conservation and Recreation (DCR) has the lead for nonpoint source control programs. Other state agencies that provide vital support include: Game and Inland Fisheries, Forestry, Health, Marine Resources Commission, Agriculture and Consumer Services, along with higher education institutions at the Virginia Institute of Marine Science and Old Dominion University.

Tributary Strategy Program

Tributary Strategies are water quality plans cooperatively developed with stakeholders in each river basin. Agencies under the Secretary of Natural Resources worked closely with local governments, Planning District Commissions, Soil and Water Conservation Districts, sanitation and wastewater authorities, conservation and river-user groups, agricultural producers, industries, and others to develop strategies that are practical and can be implemented. Reducing nutrient and sediment loads to receiving waters through the implementation of tributary strategies is a high priority for Virginia. The strategies were adopted in final form by the Secretary of Natural Resources in 2005. The tributary strategy program relies on a mix of regulatory programs and voluntary, cooperative approaches. Substantial resources have been dedicated to reduce point source and nonpoint source nutrient and sediment inputs to tidal waters.

In March 2003, Virginia replaced the 40% reduction goals and agreed to new annual load allocations for nitrogen and phosphorus and for the first time, developed allocations for sediment loading. These allocations – combined for the five major tributary basins draining to the Bay - set “cap goals” of 51.4 million pounds/yr for nitrogen, 6 million pounds/yr for phosphorus and 1.9 million pounds/yr for sediments. The point source elements of Virginia’s nutrient reduction initiative rely on a combination of several discharge control regulations, including 9 VAC 25-40: "<u>Regulation for Nutrient Enriched Waters and Dischargers within the Chesapeake Bay Watershed</u>", (which addresses numerical concentration limits), 9 VAC 25-720: "<u>Water Quality Management Planning Regulation</u>" (assigns annual nitrogen and phosphorus waste load allocations to the Significant Dischargers), and 9 VAC 25-820: “<u>Watershed General Permit for Chesapeake Bay Nutrient Discharges and Nutrient Credit Exchange Program</u>”. Implementation of nutrient reduction technology at the publicly owned treatment works affected by these Regulations is eligible for state-cost share through the Water Quality Improvement Fund program.

Point Source Tributary Strategy Plans for Nutrient Reduction

Individual waste load allocations for point sources were determined in accordance with the guiding principals of the Secretary’s August 2004 Policy Statement -- a combination of existing design capacity in conjunction with currently available and stringent treatment technologies. By summing the individual allocations, an aggregate point source allocation for each basin was developed. In September 2005, the State Water Control Board approved allocations for significant point source dischargers in the Shenandoah-Potomac, Rappahannock, and Eastern Shore Basins; final allocations for the York and James River basins were adopted in November 2005 and correspond to the new basin-specific water quality criteria for chlorophyll a and dissolved oxygen. The point source nutrient waste load allocations for each Bay tributary are expected to be achieved by the January 1, 2011 compliance deadline set in 9 VAC 25-820. This will be accomplished through a combination of retrofitting many major wastewater plants with nutrient reduction technology and use of the nutrient credit exchange program as a cost-effective alternative to upgrading every facility. Plants that achieve annual discharge loads below their allocations will have credits available for use by other facilities. These allocation credits will allow some plants to delay upgrading and relieve some of the market pressures that can cause construction prices to rise dramatically.

Current estimates of the total capital cost to achieve and maintain the point source nutrient allocations range from $1.5 to $2 billion, with the need for State cost-share potentially reaching $800 million to $1 billion. Significant appropriations, totaling approximately $387 million, have been made to the Water Quality Improvement Fund since its inception in 1997, and the 2007 General Assembly authorized the issuance of $250 million in bonds after July 2008 to support the WQIF. Additional details on implementation of the point source nutrient reduction program are available in the “*Chesapeake Bay and Impaired Waters Clean-up Plan*”, issued by the Office of the Secretary of Natural Resources, accessible at this webpage: http://www.naturalresources.virginia.gov/Initiatives/WaterCleanupPlan/.

Nonpoint Source Nutrient Reduction Actions in the Tributary Strategy Plans

Basin wide, the nonpoint source reductions call for BMPs to be installed and maintained on 92 percent of all available agricultural lands, 85 percent of all mixed open lands and 74 percent on all urban lands. As per the tributary strategy document (http://www.naturalresources.virginia.gov/Initiatives/WaterQuality/FinalizedTribStrats/ts_statewide_All.pdf), the nonpoint source approach (under the coordination of the Virginia Department of Conservation and Recreation) is to refocus available tools, steer new resources to Virginia's strongest nonpoint source control programs, and push them to maximize reductions across the landscape. These efforts will focus on seven programmatic areas:

1) Accelerate Agricultural Best Management Practices (BMP)
2) Expand Nutrient Management Planning and Implementation Efforts
3) Consolidate and Strengthen the Virginia Stormwater Management Program
4) Enhanced Implementation of the Virginia Erosion and Sediment Control Program
5) Strengthen Implementation of the Chesapeake Bay Preservation Act
6) Enhancement of the NPS Implementation Database Tracking Systems
7) Enhanced outreach, media and education efforts to reduce pollution producing behaviors

Achieving the sediment and nutrient caps is important but maintaining the caps as land use changes, population shifts and wastewater services expand will be paramount in the long run.

Water Quality and Habitat Monitoring Initiatives

Chesapeake Bay Program

Monitoring is vital to understanding environmental problems, developing strategies for managing the Bay's resources, and assessing progress of management practices. The purpose of the Chesapeake Bay Program (CBP) Water Quality and Habitat Monitoring Program is to assess status and trends in water quality and living resources throughout the Virginia portion of the Bay and its major tidal tributaries. Parameters monitored include those directly related to Water Quality Standards (e.g. dissolved oxygen, water clarity, chlorophyll *a,* etc…) as well as basic ecological health indicators such as primary productivity, nutrients, phytoplankton species, etc. A general description of Virginia's Chesapeake Bay monitoring program is:

- Water quality monitoring at 38 fixed stations on the Rappahannock, York and James Rivers;
- Water quality monitoring at 27 fixed stations in the Chesapeake Bay mainstem;
- Water quality monitoring and estimates of nutrient loading at stations on the James, Rappahannock, Mattaponi, Pamunkey, Shenandoah, Appomattox, Chickahominy and other smaller rivers throughout the Bay watershed;
- Monitoring of phytoplankton communities in the mainstem of the Chesapeake Bay at 7 stations and in the tributaries at 6 stations;
- Monitoring of benthos communities in the Bay and its tributaries at 19 fixed stations and 100 random stations per year;
- Spatially and temporally intensive monitoring of selected water quality parameters on a rotating waterbody basis for 3-year periods.

Estuarine Probabilistic Monitoring Program (Coastal 2000)

A less extensive monitoring program which probabilistically samples all of VA's estuarine waters (including those outside the Bay watershed such as on the Atlantic coast of the eastern Shore, Back Bay, and North Landing River) is the "National Coastal Assessment (NCA) Program", formerly known as the "Coastal 2000 Initiative". A detailed description of this program is provided in Chapter 2.1.

Toxics, Pollution Prevention and Businesses for the Bay Initiative

The 1987 Chesapeake Bay Agreement committed signatories to develop, adopt and begin implementation of a basin-wide toxics strategy to achieve a reduction of toxic pollutants consistent with the Water Quality Act of 1987. Following the implementation of a multi-jurisdictional effort to define the nature, extent, and magnitude of toxics problems, the strategy was further strengthened with the adoption of the 1994 Basin-Wide Toxics Reduction and Prevention Strategy. The primary goal of the 1994 strategy was to have a "*Bay free of toxics by reducing and eliminating the input of chemical contaminants from all controllable sources to levels that result in no toxic or bioaccumlative impact on living resources that inhabit the Bay or on human health".*

Building upon progress achieved through the implementation of the 1994 Strategy, the Chesapeake Bay Program adopted a revised strategy in December 2000 known as the "Toxics 2000 Strategy". With the retention of the 1994 goal, new objectives and commitments were developed and incorporated. An important strategy objective is to strive for zero release of chemical contaminants from point and non-point sources through pollution prevention and other voluntary means. For those areas with known chemical contaminant problems referenced as Regions of Concern, such as the Elizabeth River in Southeastern Virginia, the strategy includes commitments leading to their restoration. Finally, the strategy includes commitments that will provide the means to measure progress toward meeting the overall strategy goal. One approach consists of toxics characterization derived from concurrent biological and chemical monitoring.

Pollution prevention (or P2) is a hierarchy of activities and techniques to reduce or eliminate wastes at their source of generation. P2 was embraced by the Chesapeake Bay Program because many P2 techniques not only decrease chemical discharges and waste generation, but also result in increased production efficiency and reduced waste disposal costs for businesses. For this reason, business and industry have been the leaders in developing many P2 techniques and are proponents of this voluntary approach to eliminating or reducing the generation of wastes.

Working closely with representatives from business and industry, the EPA's Chesapeake Bay Program and the Pollution Prevention programs of the Bay states helped craft *Businesses for the Bay*, a voluntary pollution prevention program designed to encourage business and industry to adopt pollution prevention principles. *Businesses for the Bay* was initiated in January 1997 and it is the primary business component of the Toxics 2000 Strategy of the Chesapeake 2000 Agreement. More recently, *Businesses for the Bay* broadened its mission and it is also encouraging its membership to focus on nutrient and sediment reductions.

Membership in *Businesses for the Bay* is open to all businesses and other facilities in the Bay watershed, including federal, state and local government facilities. Each participating facility annually develops its own P2 goals and reports back on its progress of the previous year's efforts. The program also supports a business-to-business mentoring program and individual "experts" from member facilities have volunteered to provide assistance to others. Members not only benefit from cost savings and increased efficiencies but also from positive publicity, increased patronage, access to mentoring services and eligibility for annual awards from the Executive Council.

To date, there are more than 900 participants and 135 mentors in Businesses for the Bay. Virginia accounts for approximately 400 *Businesses for the Bay* members and 65 of its mentors. In 2006, Virginia participants reported approximately 102 million pounds of waste reduction and recycling, and over $2.6 million in cost savings due to pollution prevention efforts.

The Virginia DEQ's Office of Pollution Prevention actively promotes *Businesses for the Bay* through a variety of approaches, including presentations, directed mailings, a website www.deq.virginia.gov/p2/b4b, and site visits to both potential members and member facilities. In support of the efforts of *Businesses for the Bay*, Virginia has pursued partnerships and reciprocal agreements with other P2 initiatives, such as the Virginia Environmental Excellence Program, the Elizabeth River Project and the Virginia Clean Marinas Program.

The Commonwealth of Virginia hosted the *Businesses for the Bay* Annual Meeting & Awards at Westmoreland State Park in Virginia's Northern Neck on November 8, 2007. Virginia participants were honored with a total of eight B4B Excellence Awards, more than half of all the awards presented. The facilities receiving awards were:

- **City of Charlottesville**: Outstanding Achievement for Pollution Prevention - Local Government Facility
- **University of Virginia**, Charlottesville: Outstanding Achievement for Pollution Prevention - State Government Facility

- **York County School Division**, Yorktown: Outstanding Achievement for Pollution Prevention – Local Government Facility
- **Anheuser-Busch,** Williamsburg: Outstanding Achievement for Pollution Prevention - Large Facility
- **Norfolk Naval Shipyard** - Outstanding Achievement for Pollution Prevention – Federal Government Facility
- **Isle of Wight Family & Cosmetic Dentistry**, Smithfield: Outstanding Achievement for Pollution Prevention - Small Facility
- **Virginia Regional Environmental Management System**, Richmond: Partner Organization of the Year
- **Kristel Riddervold**, City of Charlottesville: Mentor of the Year

In 2008, funding for Businesses for the Bay through the Chesapeake Bay Program was discontinued from its budget. Businesses for the Bay is currently run solely by the Alliance for the Chesapeake Bay. Businesses for the Bay is a valuable program that motivates many Virginia businesses to reduce their own environmental impacts. It is hoped that sufficient funding will be made available in order to continue the program.

For more information, please access the Businesses for the Bay website at www.b4b.org. You may also contact VA DEQ's Tom Griffin at 804-698-4545 or rtgriffin@deq.virginia.gov; or you may contact the Businesses for the Bay Coordinator Marylynn Wilhere at 1-800-YOURBAY or wilhere.marylynn@epa.gov.

Assessment of Aquatic Life Use in Chesapeake Bay and Its Tidal Tributaries

Summary

The assessment process has undergone some changes for this period in comparison to the 2006 Integrated Report as a result of the new EPA Criteria assessment guidance (*"Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity, and Chlorophyll a for the Chesapeake Bay and Its tidal Tributaries, 2007 Addendum, EPA 903-R-07-003 July 2007"*). The following is a brief list of the more important changes for this 2008 assessment:

- Assessment reference curves for the 30-day dissolved oxygen criteria in Open Water and Deep Water designated uses were revised and used in this 2008 assessment.
- An assessment reference curve and procedure for Deep Channel Use dissolved oxygen instantaneous criteria were developed and used in this 2008 assessment.
- Procedures for assessing the water clarity acres criteria were developed and used in this 2008 assessment where data were available.
- Procedures for assessment of the numerical Chlorophyll criteria in the James River were developed and used in this 2008 assessment.

Two assessment changes also occurred which are unrelated to EPA guidance:

- A new SAV acres criterion was used for shallow water SAV designated use in a Rappahannock River segment (RPPOH) which previously had a zero acre criterion.
- Special dissolved oxygen standards for the Mattaponi and Pamunkey which were adopted in 2007 were applied in this assessment.

As with previous reports, this assessment found water quality impairments due to dissolved oxygen levels are not limited to the deeper and stratified waters. Shallow and better mixed areas of the Bay mainstem as well as its tributaries (e.g. James, Rappahannock and York Rivers) also have oxygen impairments. Assessment of Submerged Aquatic Vegetation continues to find that the majority of Bay waters do not attain the desired extent and acreage of this important plant community, however, new assessment of the water clarity conditions resulted in several areas attaining the Shallow Water Submerged Aquatic Vegetation Use by having sufficiently clear water to support SAV growth. Benthic biological communities (e.g. worms, insects) show slightly less area of degradation than in previous reports. The assessment of new chlorophyll criteria found that all James River segments failed these new criteria. These high chlorophyll levels as well as the other ecological problems with dissolved oxygen levels, SAV, and benthic communities will all improve as the nutrients and sediment pollution reduction activities continue to be implemented.

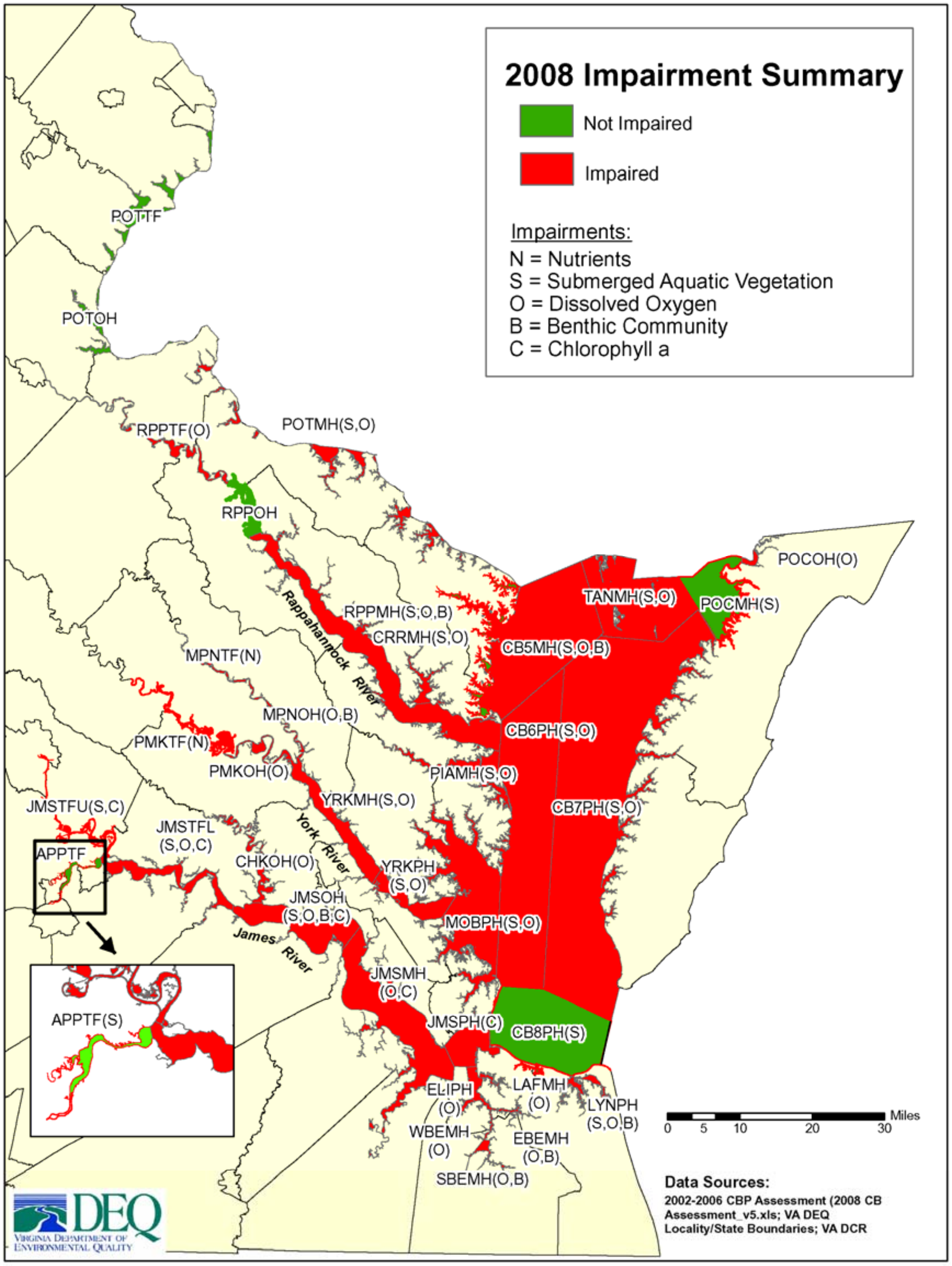
Figure 6.7-1 summarizes current Aquatic Life Use status for Bay criteria (note it does not reflect other 303(d) impairments related to pH, fish tissue contaminants, or other criteria). The only areas unimpaired are a segment in the Rappahannock (RPPOH), segments containing Virginia embayments in the middle and upper Potomac (POTTF, POTOH), some embayment portions of segment CB5MH, and smaller tributary portions not discernable at the map scale (e.g. tributary portions of segments MPNTF and PMKTF).

Some segments in the Mattaponi and Pamunkey (e.g. MPNTF and PMKTF) were originally listed in 1998 as impairment by dissolved oxygen violations caused by nutrient over enrichment (i.e. "nutrients" impairment). These segments meet all of the new Bay criteria for which they have been assessed. However, they remain classified as impaired because of the lack of assessment for the 7-day and instantaneous criteria for dissolved oxygen. There is some data to assess these criteria but an assessment protocol has not yet been developed.

A few segments (APPTF, POCOH, and CB8PH) meet dissolved oxygen criteria and benthic community criteria and are only impaired due to inadequate conditions for growth of submerged aquatic vegetation. All remaining impaired segments are impaired for dissolved oxygen, benthic macroinvertebrates, submerged aquatic vegetation, chlorophyll *a*, or some combination of these.

The following sections describe in further detail 1) Aquatic Life Uses and Criteria, 2) 2008 Aquatic Life Use Assessment Results and 3) Future Assessment Refinements.

Figure 6.7-1 Overall Impairment Summary 2008 Status (ALUS)



Chesapeake Bay and Tidal Tributaries Aquatic Life Uses and Criteria

The Chesapeake Bay tidal water aquatic life sub-uses described below reflect the different aquatic living resource communities living in the different areas of the Bay. Impairment of any of these subcategories of aquatic life use is also considered an impairment of the overall Aquatic life use (ALUS). The overall Aquatic Life Use (ALUS) of "propagation and growth of a balanced indigenous population of aquatic life, including game fish" also exists as a distinct designated use (i.e. distinct from the sub-uses) which is assessed with other protocols including benthic Indices of Biological Integrity (IBI), ammonia criteria, and toxicity bioassays.

Designated Uses

Migratory Fish Spawning and Nursery (MSN) Designated Use: Waters in the Chesapeake Bay and its tidal tributaries that protect the survival, growth and propagation of the early life stages of a balanced, indigenous population of anadromous, semi-anadromous, catadromous and tidal-fresh resident fish species inhabiting spawning and nursery grounds. Figure 6.7-2 illustrates this designated use and detailed geographic descriptions are in "*U.S. Environmental Protection Agency. 2004. Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum Chesapeake Bay Program Office, Annapolis, Maryland*". The designated use extends from the beginning of tidal waters to the downriver end of spawning and nursery habitats, as determined through a composite of all targeted anadromous and semi-anadromous fish species' spawning and nursery habitats. This designated use extends horizontally from the shoreline of the body of water to the adjacent shoreline, and extends down through the water column to the bottom water-sediment interface. This use applies February 1 through May 31 and applies in addition to the open-water use.

Shallow-Water Submerged Aquatic Vegetation (SWSAV) Designated Use: Waters in the Chesapeake Bay and its tidal tributaries that support the survival, growth and propagation of submerged aquatic vegetation (rooted, underwater bay grasses). Figure 6.7-2 illustrates this designated use and detailed geographic descriptions are in "*U.S. Environmental Protection Agency. 2004. Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum Chesapeake Bay Program Office, Annapolis, Maryland*". This use applies April 1 through October 31 in tidal-fresh, oligohaline and mesohaline Chesapeake Bay Program segments, and March 1 through November 30 in polyhaline Chesapeake Bay Program segments and applies in addition to the open-water use.

Open-Water (OW) Aquatic Life Designated Use: Waters in the Chesapeake Bay and its tidal tributaries that protect the survival, growth and propagation of a balanced, indigenous population of aquatic life inhabiting open-water habitats. Figure 6.7-2 illustrates this designated use and detailed geographic descriptions are in "*U.S. Environmental Protection Agency. 2004. Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum Chesapeake Bay Program Office, Annapolis, Maryland*". This designated use applies year-round but the vertical boundaries change seasonally. October 1 - May 31, the open water aquatic life use extends horizontally from the shoreline at mean low water, to the adjacent shoreline, and extending through the water column to the bottom water-sediment interface. June 1 - September 30, if a pycnocline (i.e. a physical inhibition of mixing) is present and, in combination with bottom bathymetry and water column circulation patterns, presents a barrier to oxygen replenishment of deeper waters, this designated use extends down into the water column only as far as the upper boundary of the pycnocline. June 1 - September 30, if a pycnocline is present but other physical circulation patterns (such as influx of oxygen rich oceanic bottom waters) provide for oxygen replenishment of deeper waters, the open-water aquatic life designated use extends down into the bottom water-sediment interface. This designated use is concurrent with the migratory fish spawning and nursery and shallow-water submerged aquatic vegetation uses in areas which have these uses.

Deep-Water (DW) Aquatic Life Designated Use: waters in the Chesapeake Bay and its tidal tributaries that protect the survival and growth of a balanced, indigenous population of aquatic life inhabiting deep-water habitats. Figure 6.7-2 illustrates this designated use and detailed geographic descriptions are in *"U.S. Environmental Protection Agency. 2004. Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum Chesapeake Bay Program Office, Annapolis, Maryland"*. This designated use applies to the tidally influenced waters located between the upper and lower boundaries of the pycnocline where, in combination with bottom bathymetry and water circulation patterns, a pycnocline is present and presents a barrier to oxygen replenishment of deeper waters. In some areas, the deep-water designated use extends from the upper boundary of the pycnocline down to the bottom water-sediment interface. This use applies June 1 through September 30.

Deep-Channel (DC) Seasonal Refuge Designated Use: Waters in the Chesapeake Bay and its tidal tributaries that protect the survival of a balanced, indigenous population of benthic infauna and epifauna inhabiting deep-channel habitats. Figure 6.7-2 illustrates this designated use and detailed geographic descriptions are in *"U.S. Environmental Protection Agency. 2004. Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum Chesapeake Bay Program Office, Annapolis, Maryland".* This designated use applies to the tidally influenced waters at depths greater than the lower boundary of the pycnocline in areas where, in combination with bottom bathymetry and water circulation patterns, the pycnocline presents a barrier to oxygen replenishment of deeper waters. This use applies June 1 through September 30.

Applicable Criteria

Dissolved oxygen criteria to protect the described uses are shown in Table 6.7-1. The methodology for assessing monitoring data against these criteria involves spatial interpolation of fixed site monitoring results to create a 3-D picture of oxygen conditions in thousands of individual grid cells throughout the Bay. Each individual grid cell is then assessed against the criteria. In this way, the volume of water in attainment is calculated for each data collection cruise and a "spatial" viewpoint achieved. In order to account for natural fluctuations over seasons and years, the individual monthly spatial assessments of a three-year time period are aggregated, creating a "temporal" viewpoint. The final assessment involves examining the cumulative frequency distribution (CFD) of attainment from the aggregated data. In this way, a combined "space-time" assessment is achieved which addresses the frequency and magnitude requirements for water quality criteria and assessments. Details of this procedure can be found in guidance manuals from EPA and DEQ ("*Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity, and Chlorophyll a for the Chesapeake Bay and Its tidal Tributaries, EPA 903-R-03-002, April 2003*" ; "*Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity, and Chlorophyll a for the Chesapeake Bay and Its tidal Tributaries, 2004 Addendum, EPA 904-R-04-005 October 2004*"; "*Water Quality Assessment Guidance Manual for Y2008: 305(B)/303(D) Integrated Water Quality Report, April, 2007*"; "*Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity, and Chlorophyll a for the Chesapeake Bay and Its tidal Tributaries, 2007 Addendum, EPA 903-R-07-003 July 2007*";"*Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries: 2008,"Criteria Assessment Protocols Addendum CBP/TRS-290-08 903-R-08-001*").

Criteria specific to the Shallow Water Submerged Aquatic Vegetation use are shown in Table 6.7-2. The criterion of "SAV Acres" was assessed in every segment. The criterion for "Water Clarity Acres" was assessed where data were available (York and James River systems). The SAV Acres criterion is met by having actual aquatic vegetation present as measured by annual aerial photography. The Water Clarity Acres criterion is met by having sufficient water clarity present to support the potential for aquatic vegetation to grow (i.e. regardless of whether the submerged aquatic vegetation is actually present). This "water clarity acres" criterion was created because the water may be clear enough to support submerged aquatic vegetation but it may take several years for the areas to re-populate with grasses.

The Chlorophyll criteria assessed for the first time in this reporting period are shown in Table 6.7-3. There are separate criteria applicable to each segment and season. If any one of the criteria (i.e. spring or summer season) is found to be failing, then the segment is assessed as failing the chlorophyll criteria.

Spatial Assessment Units

A general overview of the CBP segmentation scheme which is used for assessment of these new designated uses is shown in Figure 6.7-3. Not every designated use exists in each segment or necessarily throughout the complete segment. Details of where each designated use occurs within each of these CBP segments can be found in "*Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability, October, 2003"* and "*Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability, 2004 Addendum, October 2004".*

Figure 6.7-2 Conceptualized illustration of location of the five Chesapeake Bay tidal water Designated Use zones.

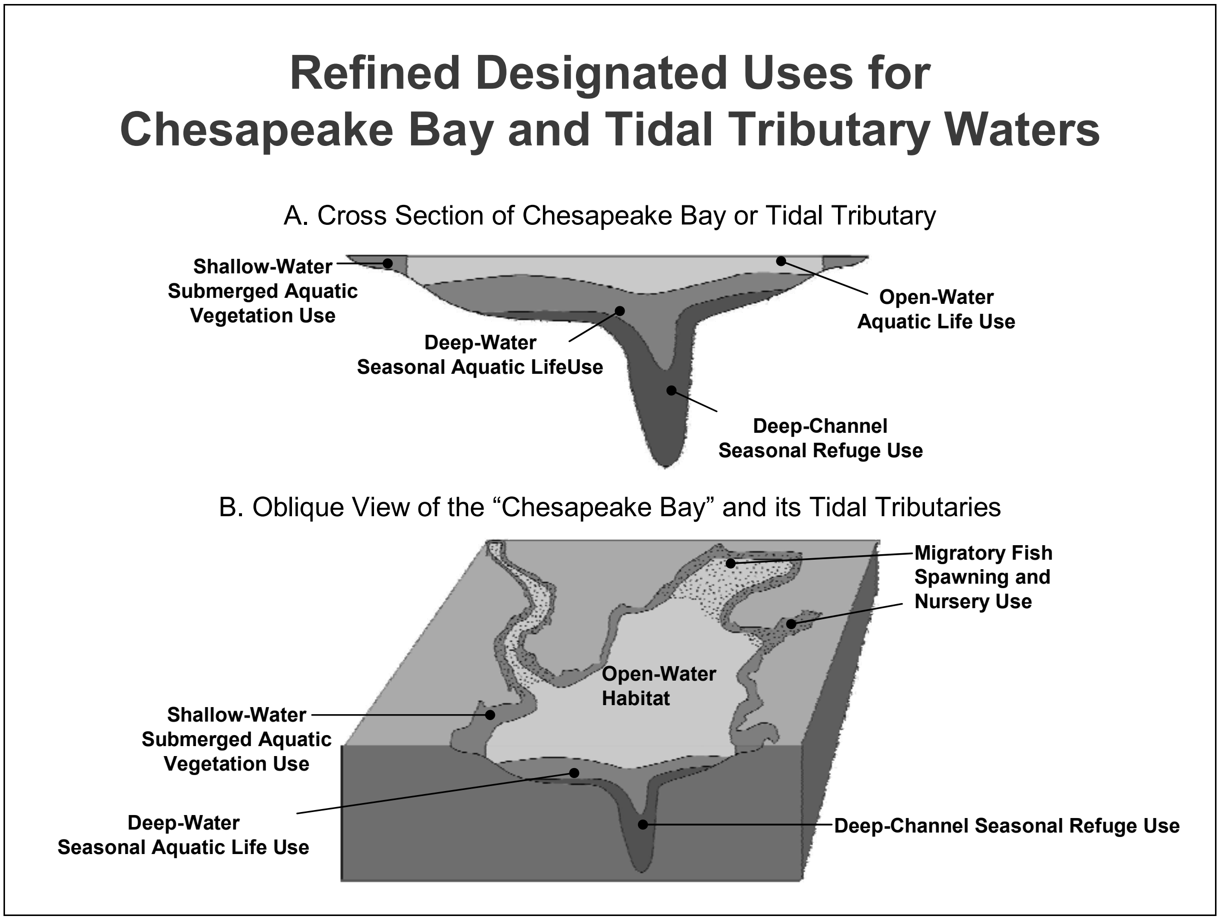


Table 6.7-1. Chesapeake Bay Dissolved Oxygen criteria.

Designated Use	Criteria Concentration/Duration	Protection Provided	Temporal Application
Migratory fish spawning and nursery use	7-day mean $\geq$ 6 mg liter^{-1} (tidal habitats with 0-0.5 ppt salinity)	Survival/growth of larval/juvenile tidal-fresh resident fish; protective of threatened/endangered species.	February 1 - May 31
	Instantaneous minimum $\geq$ 5 mg liter^{-1}	Survival and growth of larval/juvenile migratory fish; protective of threatened/endangered species.	
	Open-water fish and shellfish designated use criteria apply		June 1 - January 31
Shallow-water bay grass use	Open-water fish and shellfish designated use criteria apply		Year-round
Open-water fish and shellfish use[1]	30-day mean $\geq$ 5.5 mg liter^{-1} (tidal habitats with 0-0.5 ppt salinity)	Growth of tidal-fresh juvenile and adult fish; protective of threatened/endangered species.	Year-round
	30-day mean $\geq$ 5 mg liter^{-1} (tidal habitats with >0.5 ppt salinity)	Growth of larval, juvenile and adult fish and shellfish; protective of threatened/endangered species.	
	7-day mean $\geq$ 4 mg liter^{-1}	Survival of open-water fish larvae.	
	Instantaneous minimum $\geq$ 3.2 mg liter^{-1}	Survival of threatened/endangered sturgeon species.[2]	
Deep-water seasonal fish and shellfish use	30-day mean $\geq$ 3 mg liter^{-1}	Survival and recruitment of bay anchovy eggs and larvae.	June 1 - September 30
	1-day mean $\geq$ 2.3 mg liter^{-1}	Survival of open-water juvenile and adult fish.	
	Instantaneous minimum $\geq$ 1.7 mg liter^{-1}	Survival of bay anchovy eggs and larvae.	
	Open-water fish and shellfish designated-use criteria apply		October 1 - May 31
Deep-channel seasonal refuge use	Instantaneous minimum $\geq$ 1 mg liter^{-1}	Survival of bottom-dwelling worms and clams.	June 1 - September 30
	Open-water fish and shellfish designated use criteria apply		October 1 - May 31

[1]Special criteria for the Mattaponi and Pamunkey rivers are 30 day mean > 4.0 mg/l ;Instantaneous minimum > 3.2 mg/l at temperatures <29°C;Instantaneous minimum > 4.3 mg/l at temperatures > 29°C. These special criteria were not adopted until January 12, 2006 and therefore there was insufficient time to include these in the 2006 assessment but they have been assessed for this 2008 reporting period.

[2] At temperatures considered stressful to shortnose sturgeon (>29°C), dissolved oxygen concentrations above an instantaneous minimum of 4.3 mg liter^{-1} will protect survival of this listed sturgeon species.

Table 6.7-2. Summary of Chesapeake Bay water clarity criteria for application to shallow-water bay grass designated use habitats. Chesapeake Bay program segments are shown if Figure 6.7-2.

Chesapeake Bay Program Segment	SAV Acres[1]	Percent light-through-water[2]	Water Clarity Acres[1]	Temporal Application
CB5MH	7,633	22%	14,514	April 1 - October 31
CB6PH	1,267	22%	3,168	March 1 - November 30
CB7PH	15,107	22%	34,085	March 1 - November 30
CB8PH	11	22%	28	March 1 - November 30
POTTF	2,093	13%	5,233	April 1 - October 31
POTOH	1,503	13%	3,758	April 1 - October 31
POTMH	4,250	22%	10,625	April 1 - October 31
RPPTF	66	13%	165	April 1 - October 31
RPPOH	4	13	10	April 1 - October 31
RPPMH	1700	22%	5000	April 1 - October 31
CRRMH	768	22%	1,920	April 1 - October 31
PIAMH	3,479	22%	8,014	April 1 - October 31
MPNTF	85	13%	213	April 1 - October 31
MPNOH	-	-	-	-
PMKTF	187	13%	468	April 1 - October 31
PMKOH	-	-	-	-
YRKMH	239	22%	598	April 1 - October 31
YRKPH	2,793	22%	6,982	March 1 - November 30
MOBPH	15,901	22%	33,990	March 1 - November 30
JMSTF2	200	13%	500	April 1 - October 31
JMSTF1	1000	13%	2500	April 1 - October 31
APPTF	379	13%	948	April 1 - October 31
JMSOH	15	13%	38	April 1 - October 31
CHKOH	535	13%	1,338	April 1 - October 31
JMSMH	200	22%	500	April 1 - October 31
JMSPH	300	22%	750	March 1 - November 30
LYNPH	107	22%	268	March 1 - November 30
POCOH	-	-	-	-
POCMH	4,066	22%	9,368	April 1 - October 31
TANMH	13,579	22%	22,064	April 1 - October 31

1 = The assessment period for SAV and water clarity acres is the single best year in the most recent three consecutive years. When three consecutive years of data are not available, a minimum of three years within a six-year data assessment window is used.

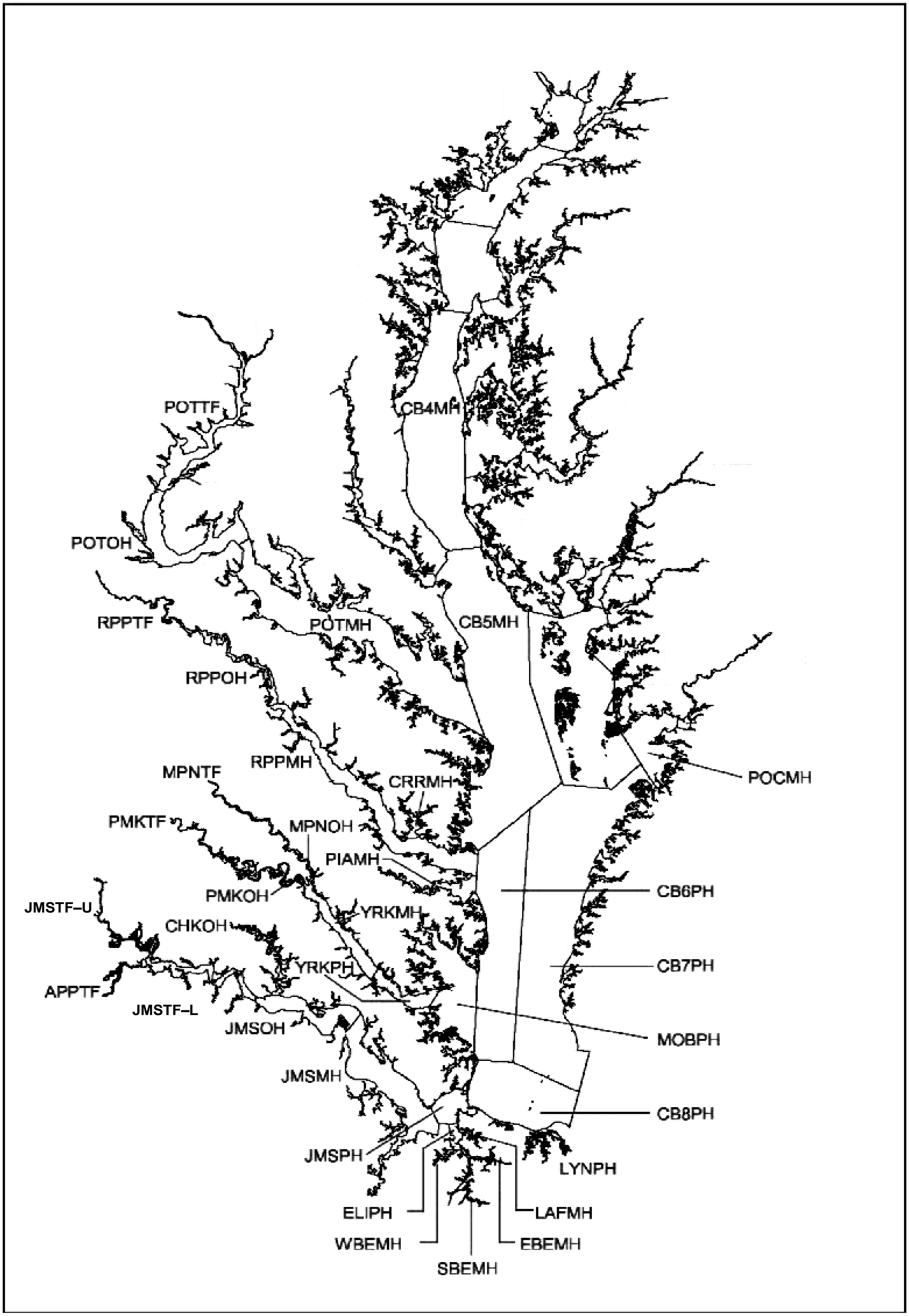
2 = Percent Light through Water = $100e^{(-K_dZ)}$ where K_d is water column light attenuation coefficient and can be measured directly or converted from a measured secchi depth where K_d = 1.45/secchi depth. Z = depth at location of measurement of K_d.

Table 6.7-3. Chlorophyll Criteria for application to open water designated use habitats in the James River.

Designated Use	Chlorophyll *a* (ug/l)	Chesapeake Bay Program Segment (1)	Temporal Application
Open-Water	10	JMSTFU (James Tidal Fresh Upper)	March 1 - May 31
	15	JMSTFL (James Tidal Fresh Lower)	
	15	JMSOH (James Oligohaline)	
	12	JMSMH (James Mesohaline)	
	12	JMSPH (James Polyhaline)	
	15	JMSTFU (James Tidal Fresh Upper)	July 1 - September 30
	23	JMSTFL (James Tidal Fresh Lower)	
	22	JMSOH (James Oligohaline)	
	10	JMSMH (James Mesohaline)	
	10	JMSPH (James Polyhaline)	

1) See Figure 6.7-3 for locations of these segments.

Figure 6.7-3) Chesapeake Bay dissolved oxygen and water clarity assessment segmentation.



1) Chesapeake Bay Aquatic Life Use Assessment Results

Open Water Designated Assessment*:*

Figure 6.7-4 shows attainment of the 30-day mean criterion for dissolved oxygen (DO) in the “Open Water” designated use. Overall results are similar to those reported in 2006, with failure of the criteria observed in the majority of segments during the summer assessment period. As in 2006, several small areas such as portions of the York (YRKPH), the Lynnhaven (LYNPH), and branches of the Elizabeth River (SBEMH, EBEMH, and WBEMH) also fail during the non-summer assessment period. Violation rates are slightly higher than those reported in 2006.

Attainment of the DO criteria was achieved in the upriver portions of most major tributaries [James (JMSTFU), Appomattox (APPTF), Mattaponi (MPNTF), Pamunkey (PMKTF), and Potomac (POTTF)]. Attainment of the assessed criteria was also achieved in about 35% of the mainstem Bay (i.e. segments CB5PH and CB8PH, and Pocomoke sound (POCMH)) and Lower James (JMSPH).

The highest DO violation rate was observed in the Southern Branch of the Elizabeth River (SBEMH) with a 56% exceedance rate during the summer period. Other high rates of exceedance were observed in the Pocomoke (POCOH, 41%). A somewhat surprising finding is the relatively high violation rate of 13% in the tidal fresh James River (JMSTFL). This is a significantly higher violation rate than found in the 2006 reporting period when it was only 4.4%.

Several large segments failed but had very low DO exceedance rates. The Bay mainstem segment CB6PH had only 1.4% criteria exceedance and the lower Rappahannock (RPPMH) had only 0.3% exceedance.

Use of the most recent DO criteria in tidal fresh Mattaponi and Pamunkey Rivers (MPNTF, PMKTF) yielded attainment of the criteria in these segments during this reporting period as opposed to their failure in the 2006 reporting period. The oligohaline Mattaponi and Pamunkey Rivers (MPNOH, PMKOH) still fail under the new criteria used for these segments.

Figure 6.7-6 shows an evaluation of where the chlorophyll criteria for this use are attained. Every James River segment except the oligohaline segment (JMSOH) fails the criteria during both assessment periods. Violation rates ranged from 8% to 47%. Violation rates were generally higher in the summer period (26-29%) as opposed to the spring season where several segments had only an 8% violation rate.

Deep Water Aquatic Life Designated Use Assessment

Figure 6.7-6 shows attainment of the 30-day mean criterion for dissolved oxygen in the “Deep Water Aquatic Life” designated use. The Deep Water criteria is attained in part of the mainstem bay (CB7PH) and in the mesohaline Potomac embayments (POTMH) and failed in the remaining areas (i.e. parts of mainstem Chesapeake Bay, mouth of the Rappahannock River, mouth of the York River, Southern branch of the Elizabeth River). Violation rates range from 0.1% in the York (YRKPH) to 9% in the Rappahannock (RPPMH).

Deep Channel Designated Use Assessment

Assessment of the instantaneous oxygen criteria in the Deep Channel designated use was performed for the first time in this reporting period. Figure 6.7-6 shows attainment status of the instantaneous criterion for dissolved oxygen (see inset box). This use exists only in relatively small areas of Rappahannock mesohaline segment (RPPMH), the mainstem Bay segment CB5PH, and the Potomac mesohaline embayments (POTMH). Similar to the deep water criteria for these segments, the deep channel criteria was not met in the Rappahannock and the mainstem Bay segments. In the Potomac embayments segment, there was insufficient occurrence of this use during this reporting period to perform an assessment. Violation rates for this criterion were relatively low (2.0% in mainstem Bay and 2.4% in the Rappahannock)

Shallow Water Designated Use Assessment

Figure 6.7-7 shows an evaluation of the shallow water submerged aquatic vegetation (SWSAV) designated use. This designated use is attained if there are sufficient acres of submerged aquatic vegetation mapped by annual aerial surveys or if the water is sufficiently clear (i.e. has sufficient “water clarity” acres) so that SAV regrowth is possible. This is because lack of SAV growth may have non-pollutant causes such as insufficient propagule availability, herbivory by turtles and waterfowl, or habitat disruption by cow-nosed rays.

Full attainment of the SWSAV use is present in areas of each of the major tributary systems (James, York, Rappahannock and Potomac). A few of the segments in the James (JMSMH, JMSPH) meet the Use because of having sufficient water clarity (i.e. it meets the water clarity acres criterion) even though the SAV itself has not returned in sufficient acreage to attain that criterion. Figure 6.7-7 shows that these segments attain the SWSAV Use though they are still 198 acres (JMSMH) and 157 acres (JMSPH) short of achieving their SAV acres criterion.

The Bay tributaries historically had relatively little SAV habitat in comparison to the mainstem Bay where the largest shortfall of vegetation occurs. The open Bay areas with larger shoals have a combined shortfall of 23,359 acres for segments CB5-VA, TANMH-VA, POCMH-VA, CB7PH, and MOBPH. The overall shortfall of SAV acres in all segments is 54% of the criterion (i.e. only 46% of the total VA SAV acreage goal has been reached). This represents 41,968 Acres of SAV which must be restored before this designated use will be met throughout the Bay and Tributaries. Alternatively, sufficient water clarity must be present to at least potentially support this many acres of submerged aquatic vegetation.

Figure 6.7-4) Attainment of Open Water Designated Use (Dissolved Oxygen Criteria) in 2008.

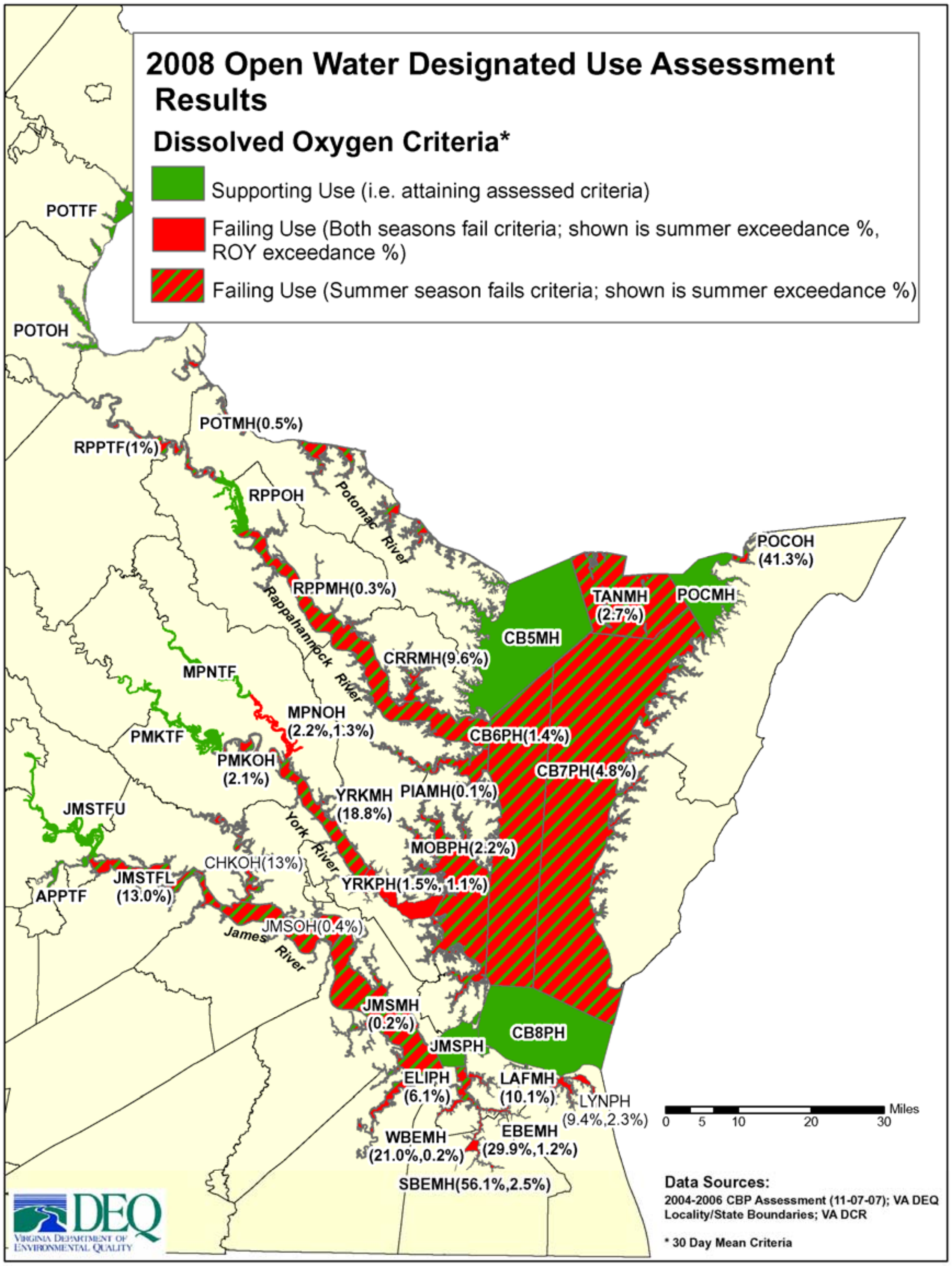


Figure 6.7-5) Attainment of Open Water designated use (Chlorophyll criteria) in 2008.

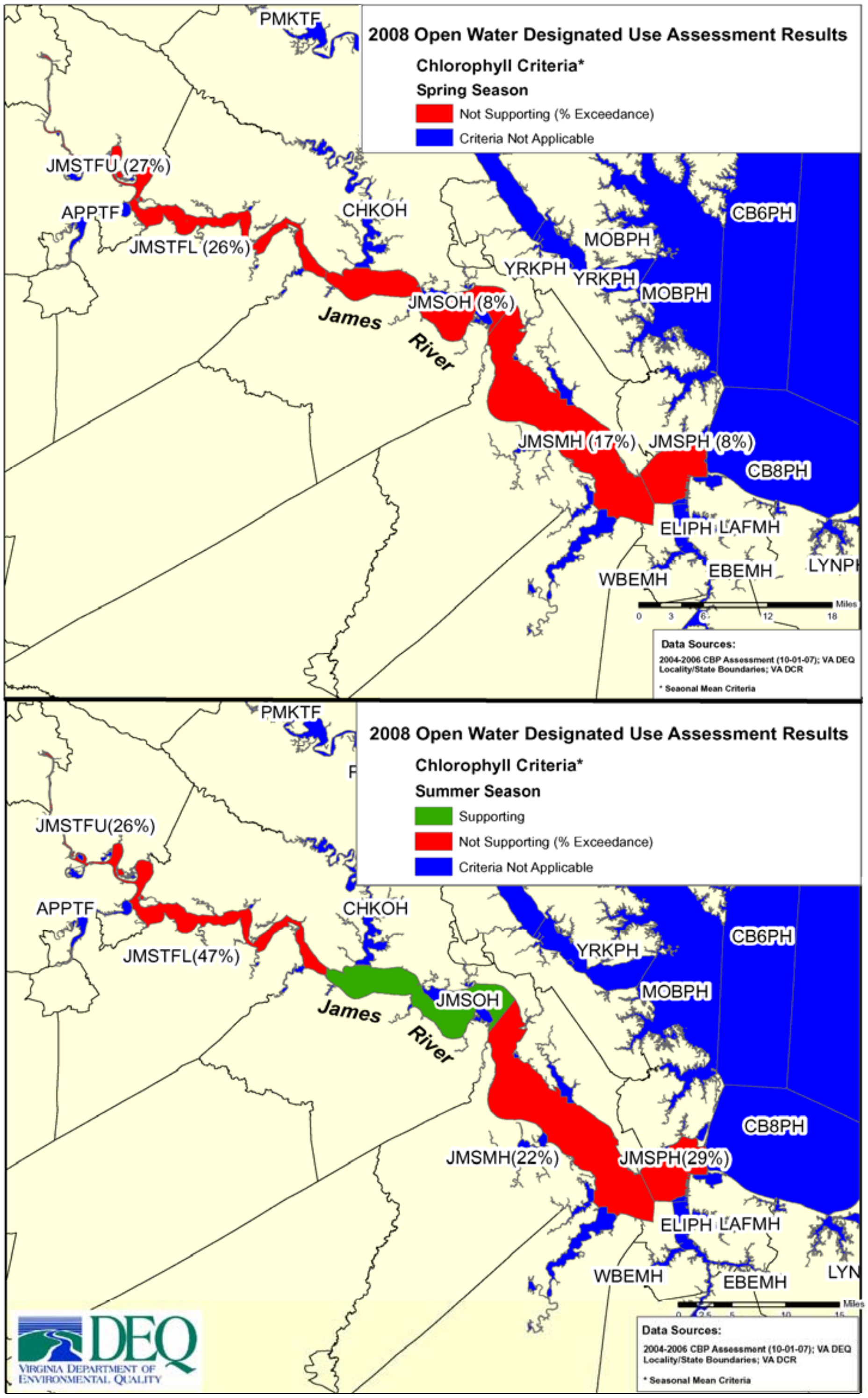


Figure 6.7-6) Attainment of Deep Water and Deep Channel Designated Use (Dissolved Oxygen Criteria) in 2008.

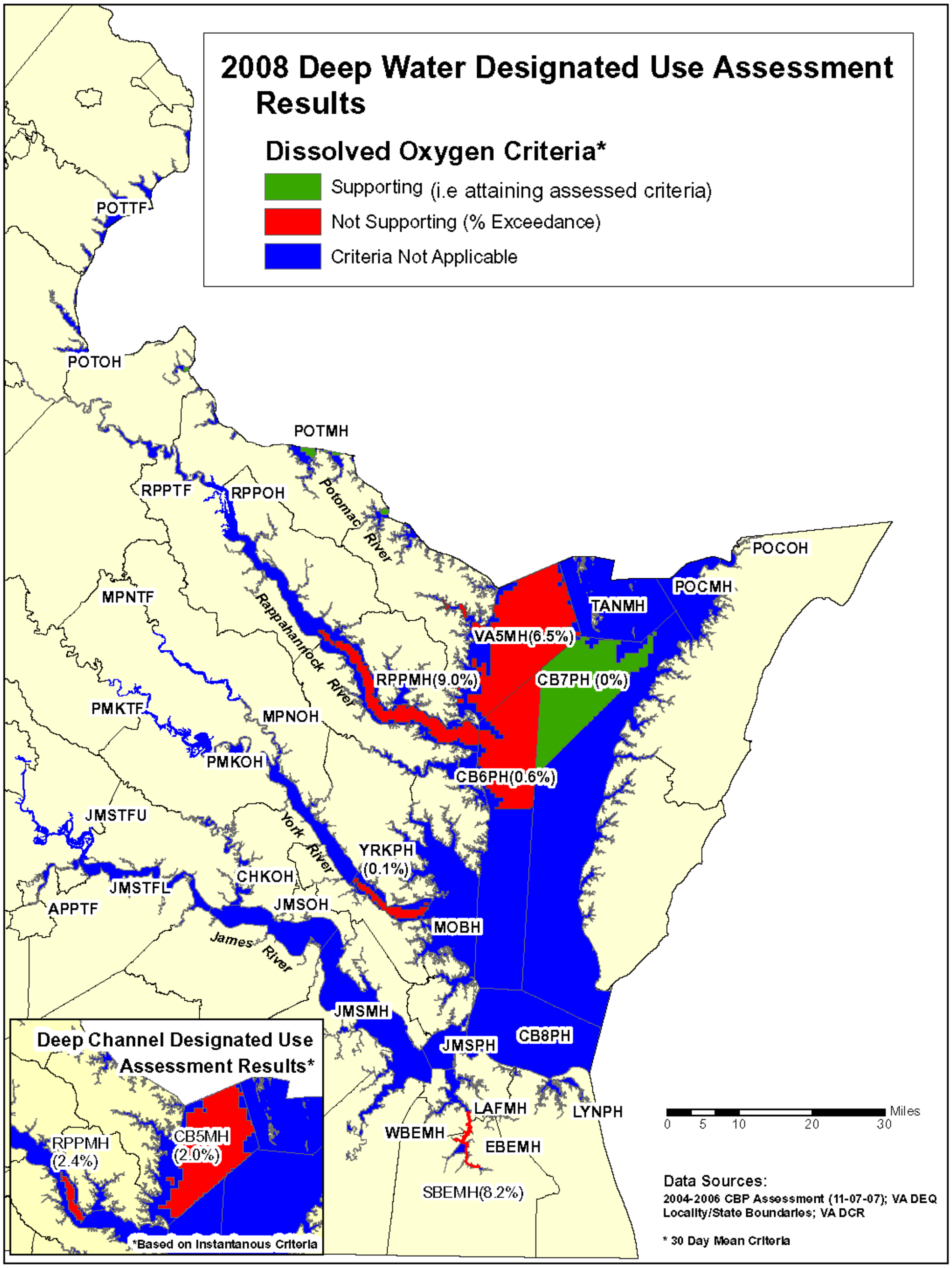
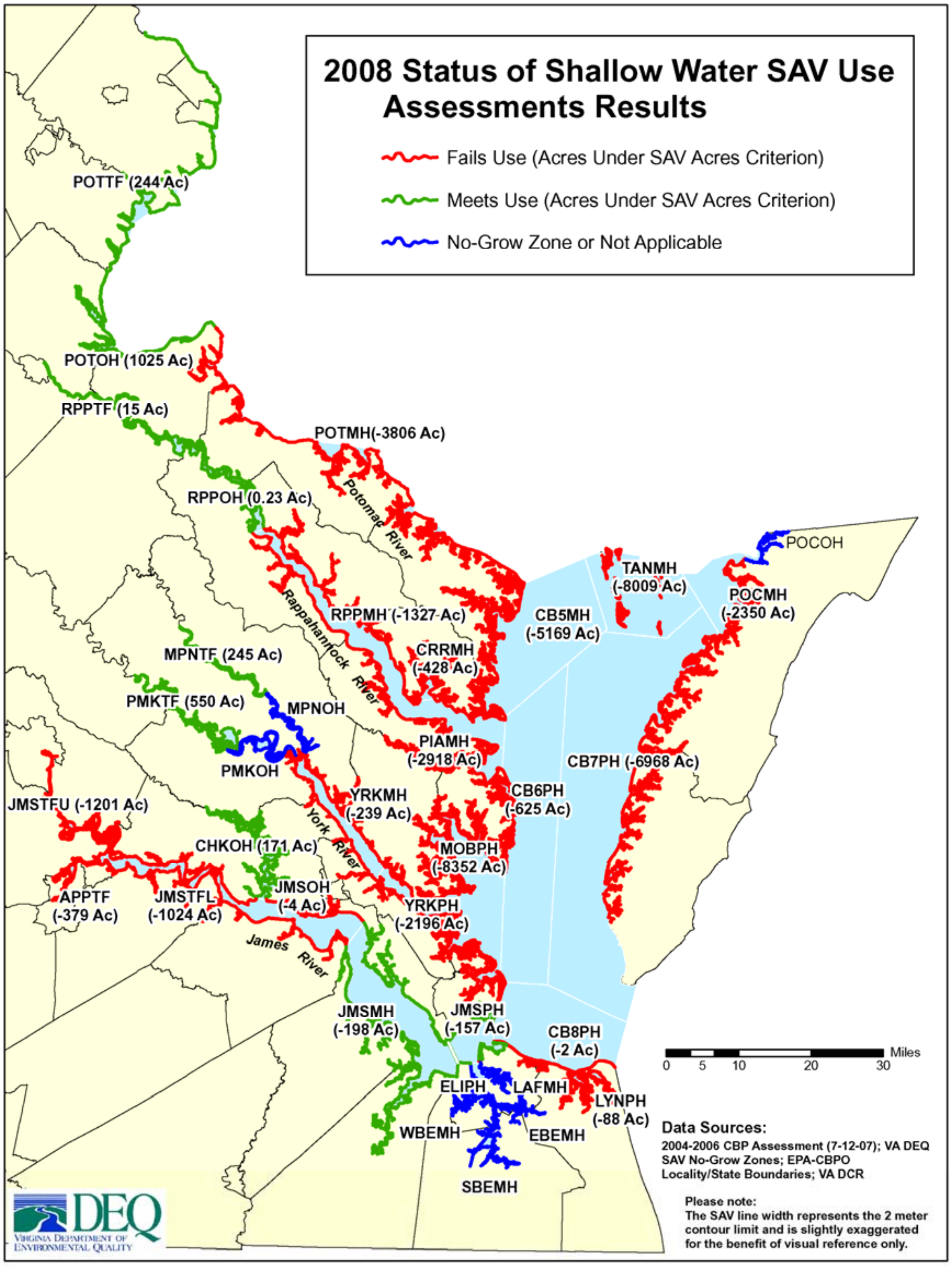


Figure 6.7-7) Attainment of SWSAV Designated Use (SAV Acres and Water Clarity Acres criteria) in 2008.



Aquatic Life Designated Use Assessment (ALUS) Estuarine Benthic Bioassessment

Assessment of the general Aquatic Life Use as indicated by benthic community health throughout Chesapeake Bay and its tidal tributaries was performed in cooperation with EPA Region III, EPA Chesapeake Bay Program, Maryland Department of the Environment, Maryland Department of Natural Resources and the Virginia Department of Environmental Quality. This section describes the assessment protocol and summarizes the key results. Technical details of statistical methods were previously described in "*2006 303(D) Assessment Methods For Chesapeake Bay Benthos, Final Report Submitted to Virginia Department of Environmental Quality, Roberto J. Llansó, Jon H. Vølstad, Versar Inc., Daniel M. Dauer, Michael F. Lane, Old Dominion University, September 2005*".

The overall assessment protocol is conducted in three phases as shown in Figure 6.7-8. Table 6.7-4 shows the possible outcome scenarios from the three phases of the protocol.

Phase I examines if the sample size satisfies the requirements of the statistical method ($N \geq 10$) during the six-year assessment window. Phase II consists of the aquatic life use impairment assessment based on a comparison of Benthic Index of Biotic Integrity (B-IBI) scores between reference conditions and the assessment data utilizing a "percent degraded area" statistical methodology. Phase II can result in one of two possible outcomes: (1) the segment is not impaired for Aquatic Life use due to benthic community status (note that the segment may still be impaired for aquatic life use due to failure of the other Chesapeake Bay aquatic life use subcategories), or (2) the segment fails to support aquatic life use due to benthic community status and is assessed as impaired.

Phase III consists of the identification of probable causes of benthic impairment of the waterbody segment based upon benthic stressor diagnostic analyses. It is a two step procedure that involves (1) Site Classification, and (2) Segment Characterization.

1) Site classification: The first step is to assign probable sources of benthic degradation to each individual "degraded" benthic sample. For the purpose of these diagnostic analyses, a sample is considered degraded if the B-IBI score is less than 2.7.

<u>Site Classification - Step 1a</u>: The application of a formal statistical linear discriminant function calculates the 'inclusion probability' of each degraded site belonging to a 'contaminant caused' group or an 'other causes' group, based upon its B-IBI score and associated metrics. If a site is assigned to the 'Contaminant' Group with a probability ≥ 0.9, this site is considered impacted by contaminated sediment and no further classification is required.

<u>Site Classification - Step 1b</u>: If a site is classified as degraded due to 'other causes' (*i.e.*, not contaminant-related), an evaluation of the relative abundance (and/or biomass) of the benthos is examined. Scores for both abundance and biomass are considered to be bipolar for the Chesapeake Bay Benthic IBI. For either metric; a high score of 5, indicating desirable conditions, falls in the mid-range of the abundance/biomass distributions, while a low score of 1, indicating undesirable conditions, can result either from insufficient abundance/biomass or excessive abundance/biomass. The scoring thresholds for these two metrics vary with habitat type (salinity regime and substrate type). In this process, a site is classified as degraded by "low dissolved oxygen" if the abundance (and/or biomass) metric scores a 1 due to insufficient abundance (and/or biomass). Alternatively, if the abundance (and/or biomass) metric scores a 1 because of excessive abundance (and/or biomass) the site is classified as degraded by "eutrophication".

2) Segment classification: The assignment of probable causes of benthic degradation for the overall segment is accomplished using a 25% rule. If the percent of total sites in a segment impacted by a single cause (i.e. sediment contaminants, low dissolved oxygen, or eutrophication) exceeds 25%, then that cause is assigned. If no causes exceed 25%, the cause is considered unknown. In the ADB database, the cause(s) are identified as a suspected (vs. verified) cause of benthic community degradation.

Figure 6.7-8) Estuarine Benthic Bioassessment Protocol (an ALUS criterion).

Overall Decision Protocol.

Phase I		Phase II		Phase III
Sample Size Evaluation		**Impairment Assessment**		**Segment Characterization** **(Identify Probable Causes)**
N < 10?	**Yes →**	**Insufficient sample size to conduct statistical assessment** **Optional use of B-IBI scores and diagnostic analyses as adjunct to other available data**		
↓ No				
N ≥ 10?	**Yes →**	**Apply Degraded Area Statistical method**		
		↓		
		Statistics indicate 'not impaired' for benthic aquatic life? **Optional use of B-IBI scores and diagnostic analyses in conjunction with other available data**		
		↓ No		
		Statistics indicate 'impaired' for benthic aquatic life	**Yes →**	**Apply diagnostic analyses for assignment of suspected cause(s) of degradation**

Table 6.7- 4) Outcome scenarios from benthic biological assessment. From: 2006 303(D) Assessment Methods For Chesapeake Bay Benthos, Final Report Submitted to: Virginia Department of Environmental Quality, Roberto J. Llansó, Jon H. Vølstad Versar, Inc., Daniel M. Dauer Michael F. Lane, Old Dominion University, September 2005

n>=10 - sufficient sample size for assessment

	Impairment Analysis		Stressor Diagnostic Analyses		
Scenario	**CL-L ($P-P_0$) (Table 3 of VERSAR Technical Report)**	**Impaired: Degraded Area method? (Table 3 of VERSAR Technical Report)**	**Samples with contaminant Posterior Prob. *p*>= 0.90; % of Total (Table 5 of VERSAR Technical Report)**	**Degraded Samples with excessive Abundance/Biomass; % of Total w/o Cont. (Table 5 of VERSAR Technical Report)**	**Degraded Samples with Insufficient Abundance/Biomass; % of Total w/o Cont. (Table 5 of VERSAR Technical Report)**
1	≤0	No	review as supplemental info	review as supplemental info	review as supplemental info
• A small, non-significant fraction of IBI scores are within or below the lower range of the reference distribution so water quality conditions in this segment support the benthic community (no impairment). • Where community samples are degraded, the stressor analyses may provide information that supports other assessment data.					
2	>0	Yes	≤ 25% of Total Samples	≤ 25% of Total Samples	≤ 25% of Total Samples
• A large, significant fraction of IBI scores are within or below the lower range of the reference distribution, so water quality conditions in this segment do not support the benthic community (impaired condition). • Stressor diagnostic analyses do not suggest dominant stressors affecting community composition. Cause of degradation is "unknown".					
3	>0	Yes	> 25% of Total Samples	≤ 25% of Total Samples	≤ 25% of Total Samples
• A large, significant fraction of IBI scores are within or below the lower range of the reference distribution, so water quality conditions in this segment do not support the benthic community (impaired condition). • Stressor diagnostic analyses suggest sediment contaminants as a likely pollutant affecting benthic community structure.					
4	>0	Yes	> 25% of Total Samples	> 25% of Total Samples	≤ 25% of Total Samples
• A large, significant fraction of IBI scores are within or below the lower range of the reference distribution, so water quality conditions in this segment do not support the benthic community (impaired condition). • Stressor diagnostic analyses suggest sediment contaminants as a likely pollutant affecting benthic community structure. Observation of high biomass or abundance is indicative of eutrophic conditions as an additional stressor affecting the benthic community.					
5	>0	Yes	> 25% of Total Samples	≤ 25% of Total Samples	> 25% of Total Samples
• A large, significant fraction of IBI scores are within or below the lower range of the reference distribution, so water quality conditions in this segment do not support the benthic community (impaired condition). • Stressor diagnostic analyses suggest sediment contaminants as a likely pollutant affecting benthic community structure. Samples observed with low biomass or abundance is indicative of low dissolved oxygen as an additional stressor affecting the benthic community.					
6	>0	Yes	≤ 25% of Total Samples	> 25% of Total Samples	≤ 25% of Total Samples
• A large, significant fraction of IBI scores are within or below the lower range of the reference distribution, so water quality conditions in this segment do not support the benthic community (impaired condition). • Stressor diagnostic analyses do not suggest sediment contaminants as a stressors affecting community composition. Samples observed with high biomass or abundance is indicative of eutrophic conditions (excessive nutrients) as a stressor affecting the benthic community.					
7	>0	Yes	≤ 25% of Total Samples	> 25% of Total Samples	> 25% of Total Samples
• A large, significant fraction of IBI scores are within or below the lower range of the reference distribution, so water quality conditions in this segment do not support the benthic community (impaired condition). • Stressor diagnostic analyses do not suggest sediment contaminants as stressor affecting community composition. Samples observed with high biomass or abundance are indicative of eutrophic conditions within the segment while other samples observed with low biomass or abundance are indicative of low dissolved oxygen as another stressor within the segment.					
8	>0	Yes	≤ 25% of Total Samples	≤ 25% of Total Samples	> 25% of Total Samples

<table>
<tr><td colspan="7">Table 6.7- 4) Outcome scenarios from benthic biological assessment. From: <u>2006 303(D) Assessment Methods For Chesapeake Bay Benthos, Final Report Submitted to: Virginia Department of Environmental Quality, Roberto J. Llansó, Jon H. Vølstad Versar, Inc., Daniel M. Dauer Michael F. Lane, Old Dominion University, September 2005</u></td></tr>
<tr><td colspan="7">• A large, significant fraction of IBI scores are within or below the lower range of the reference distribution, so water quality conditions in this segment do not support the benthic community (impaired condition).
• Stressor diagnostic analyses do not suggest sediment contaminants as a stressor affecting community composition. Samples observed with low biomass or abundance is indicative of low dissolved oxygen as a stressor affecting the segment.</td></tr>
<tr><td>9</td><td>>0</td><td>Yes</td><td>> 25% of Total Samples</td><td>> 25% of Total Samples</td><td>> 25% of Total Samples</td></tr>
<tr><td colspan="7">• A large, significant fraction of IBI scores are within or below the lower range of the reference distribution, so water quality conditions in this segment do not support the benthic community (impaired condition).
• Stressor diagnostic analyses suggest sediment contaminants as a likely pollutant affecting benthic community structure. Samples observed with high biomass or abundance are indicative of eutrophic conditions within the segment while other samples observed with low biomass or abundance are indicative of low dissolved oxygen as an additional stressor within the segment.</td></tr>
<tr><td colspan="7">n<10 – small sample size, insufficient for analysis</td></tr>
<tr><td>1</td><td>n/a</td><td>Unknown, Not Assessed</td><td>review as supplemental info</td><td>review as supplemental info</td><td>review as supplemental info</td></tr>
<tr><td colspan="7">• There are too few samples to define the confidence interval of benthic sample IBIs, so in this segment – the biological community condition is unknown.
• Where community samples are identified as degraded, information from the stressor diagnostic analyses may provide supplemental information that may support other assessment data.</td></tr>
</table>

Table 6.7-5a shows the estuarine benthic bioassessment results for 2008. Each segment is indicated as impaired or not impaired as well as the suspected source of impairment and miscellaneous statistics. Table 6.7-5b identifies the corresponding waterbodies for each segment ID's. The assessment segmentation for benthic health is slightly different than that used for the other Bay criteria. For benthos, segments consist of only the mainstem of major tidal tributaries (this also means the segmentation is according to named waterbodies). For example, the mesohaline James CBP segment (JMSMH in figure 6.7-3) is subdivided into a "mainstem" James River assessment segment (i.e. JMSMHa of table 6.7-5b) and a separate Nansmond River benthic assessment segment (i.e. JMSMHb of table 6.7-5b). Each of these sub-segments has a separate benthic assessment result as shown in figure 6.7-9.

Figure 6.7-9 shows a map of the results presented in table 6.7-5a. Approximately 387 square miles of estuarine waters are impaired for Aquatic Life Use as indicated by benthic community assessment. This represents 20% of the total assessed square miles. This impaired area is smaller than the impaired area in the 2006 report (643 sq. miles) because of 2008 attainment in several large segments which were previously impaired (James Mesohaline (JMSMH), York Mesohaline (YRKMH) and Mobjack Bay (MOBPH)). It should be noted that the total Bay system area impaired for benthics reported in Chapter 3 may be slightly higher than these numbers because these numbers do not include impairments identified by the national coastal assessment sampling program.

Most of the impairments occur in the middle and down-river parts of the tributaries and in the northern part of the Bay mainstem. The up-river parts of the James, Rappahannock, and Mattaponi River as well as most of the Bay mainstem attain the benthic community health criteria.

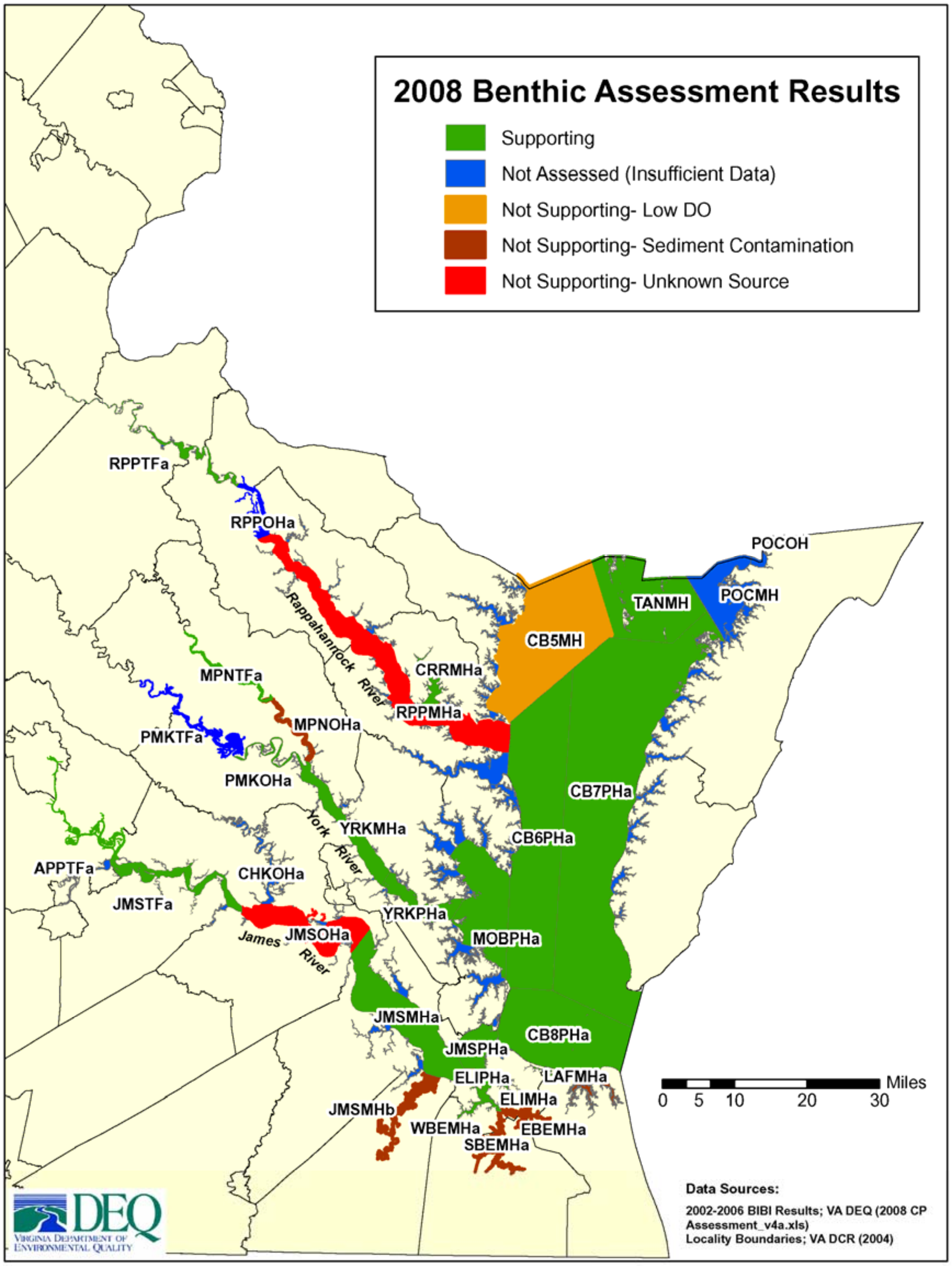
The predominant source of benthic community degradation is low dissolved oxygen, affecting 199 square miles. As expected, this occurs in the upper VA Bay mainstem, where there are extensive low dissolved oxygen levels in bottom waters. The second largest category of degradation is from sources which cannot be determined (i.e. "unknown" source category), characterizing 160 square miles. Sediment contaminants are the third largest source, affecting 27 square miles. As would be expected by their proximity to highly urbanized areas, these sediment contaminants are a major source of degradation in the Nansmond, tributaries within the Elizabeth River system (i.e. Southern Branch, Eastern Branch) and the Lynnhaven River. Perhaps less expected is the degradation of the Mattaponi from a sediment contaminant source.

Table 6.7- 5a) Estuarine Benthic Analysis

Segment	Impaired (Y/N)	Mean B-IBI	Sample Size	% of Total Samples with contaminant Posterior Prob. (p>= 0.90)	% of Total Degraded Samples with excessive Abundance/Biomass (w/o Contaminants)	% of Total Degraded Samples with Insufficient Abundance/Biomass (w/o Contaminant)	Suspected Sources of Degradation
CB5MH	**YES**	2.6	62	16%	0%	31%	Low DO
CB6PHa	NO	3.2	22	5%	5%	9%	Unknown
CB7PHa	NO	3.2	52	0%	2%	9%	Unknown
CB8PHa	NO	3.2	17	6%	0%	12%	Unknown
CRRMHa	NO	2.3	12	0%	0%	17%	Unknown
EBEMHa	**YES**	2.3	15	47%	0%	0%	Sediment Contaminants
ELIMHa	**YES**	2.4	54	20%	7%	2%	Unknown
ELIPHa	NO	2.7	24	13%	4%	0%	Unknown
JMSMHa	NO	2.7	68	13%	4%	7%	Unknown
JMSMHb	**YES**	2.4	17	47%	0%	0%	Sediment Contaminants
JMSOHa	**YES**	2.8	26	23%	0%	4%	Unknown
JMSPHa	NO	3	14	0%	0%	0%	Unknown
JMSTFa	NO	3.1	28	11%	0%	4%	Unknown
LAFMHa	NO	2.4	26	38%	4%	0%	Sediment Contaminants
LYNPHa	**YES**	2.1	176	28%	5%	13%	Sediment Contaminants
MOBPHa	NO	2.8	17	24%	6%	6%	Unknown
MPNOHa	**YES**	2.6	10	27%	0%	9%	Sediment Contaminants
MPNTFa	NO	3.6	12	0%	0%	0%	Unknown
PMKOHa	NO	2.9	13	38%	0%	0%	Unknown
RPPMHa	**YES**	2.4	127	16%	2%	20%	Unknown
RPPTFa	NO	3.2	14	14%	0%	0%	Unknown
SBEMHa	**YES**	2	47	51%	17%	2%	Sediment Contaminants
TANMH	NO	3.2	48	8%	0%	0%	Unknown
WBEMHa	NO	2.4	24	42%	8%	0%	Sediment Contaminants
YRKMHa	NO	2.5	78	22%	8%	3%	Unknown
YRKPHa	NO	2.6	40	18%	3%	5%	Unknown

Table 6.7- 5b) Segment ID’s and corresponding waterbody.	
Segment	**Waterbody**
APPTFa	Appomattox River, Mainstem of APPTF
MPNOHa	Mattaponi River, mainstem of MMPNOH
MPNTFa	Mattaponi River, mainstem of MPNTF
CB5MH	Maryland/Virginia mainstem
CB6PHa	Virginia Bay, mainstem of CB6PH
CB7PHa	Virginia Bay, mainstem of CB7PH
CB8PHa	Virginia Bay, mainstem of CB8PH
EBEMHa	Elizabeth River Eastern Branch
ELIMHa	Elizabeth River, mainstem of ELIMH
ELIPHa	Elizabeth River, mainstem of ELIPH
JMSMHa	James River, Mainstem of JMSMHa
JMSMHb	Nansmond River
JMSOHa	James River, mainstem of JMSOHa
JMSPHa	James River, mainstem of JMSPH
POCMH	Pocomoke Sound
POCOH	Pocomoke River
POCTF	Pocomoke River
MPNOHa	Mattaponi River, mainstem of MOBPH
PMKTFa	Pamunkey River, mainstem of PMKTF
PMKOHa	Pamunkey River, Mainstem of PMKOH
SBEMHa	Elizabeth River Southern Branch, mainstem of SBEMH
WBEMHa	Elizabeth River Western Branch, mainstem of WBEMH
JMSTFa	James River, mainstem of JMSTF
LAFMHa	Lafayette River
MOBPHa	Mobjack Bay
TANMH	Tangier Sound
POCMH	Pocomoke Sound
POCOH	Pocomoke River
POCTF	Pocomoke River
RPPMHa	Rappahannock River, mainstem of RPPMH
RPPMHd	Robinson Creek
RPPMHm	Totuskey Creek
RPPOHa	Rappahannock River
RPPTFa	Rappahannock River, mainstem of RPPTF
TANMH	Tangier Sound
YRKMHa	York River, mainstem of YRKMH
YRKMHb	Queen Creek
YRKPHa	York River, mainstem of YRKPH

Figure 6.7-9 Estuarine Benthic Biological Assessment (an ALUS criterion)



Chesapeake Bay and Tributaries Aquatic Life Use and Sub-use Listing Methodology

The Integrated Report listing assignment methodology addresses the goals of maintaining continuity with previous methodologies; accurately reflecting the assessment results of new uses and criteria; and most importantly, protecting and restoring aquatic life. The listing methodology for the new Aquatic Life Use subcategories was developed by a Water Quality Criteria Assessment Workgroup involving EPA Region III, EPA Chesapeake Bay Program, Maryland Department of the Environment, Maryland Department of Natural Resources, and the Virginia Department of Environmental Quality. The workgroup's efforts will continue through future modifications as necessary to assure Bay-wide consistency. The main rules for designated use attainment are:

- Aquatic Life Use (i.e. ALUS) is listed as impaired (i.e. category 5A) if any aquatic life sub-use (i.e. SWSAV, MSN, OW, DW, DC) is impaired (i.e. category 5A). The sub-use impairment cause (e.g. dissolved oxygen, aquatic vegetation, or chlorophyll-a) is designated as both the sub-use and the ALUS impairment cause.

- Assessment units previously listed as impaired (i.e. category 5A) for Aquatic Life Use (ALUS) from impacts of low dissolved oxygen or nutrients will remain on category 5A until all applicable criteria for aquatic life sub-uses are assessed. This "carry-forward" of previous impairments will be listed as ALUS impairment due to dissolved oxygen cause (if previous listing was for dissolved oxygen) or "biological indicators/nutrient enrichment" cause (if "nutrients" was the cause listed previously). An exception is:

    - Mattaponi (MPNTF, MPNOH) and Pamunkey (PMKTF, PMKOH) Rivers were listed in 2006 as failing OW dissolved oxygen criteria. The dissolved oxygen criteria used in 2006 and previous assessments were inappropriate and new criteria were adopted in January 2006. These previous, inappropriate, OW dissolved oxygen impairments will not "carry-forward" as described above.

- All applicable dissolved oxygen criteria must be assessed and attained in order for a sub-use (i.e. MSN, OW, DW, DC) to be supported (i.e. category 2A). If only a sub-set of applicable dissolved oxygen criteria are attained (e.g. only the 30-day criteria) and remaining criteria (e.g. 7-day, instantaneous) are un-assessed, the sub-use will be listed as "insufficient data" (category 3B). Exceptions are:

    - If a sub-use was first listed as impaired for dissolved oxygen in 2006 due to failure of the 30-day dissolved oxygen criteria and then subsequent 30-day dissolved oxygen criteria are met. In this case, the sub-use will be delisted from category 5A to category 2A (e.g. open water use within segments POTOH and POTTF). If this sub-use was the only reason for ALUS impairment, then the ALUS impairment will also be de-listed.

    - If a segment was never previously listed as impaired for dissolved oxygen impacts (i.e. RPPOH, CB8PH, POCMH, APPTF, JMSPH, and JMSTFU). In this case the sub-use will be listed as supporting (2A) if the assessed criteria have been attained (i.e. OW use) or insufficient data (i.e. 3B) if none of the criteria for that sub-use are assessed (e.g. MSN use).

- The Shallow Water Submerged Aquatic Vegetation (SWSAV) use is fully supporting if any of the criteria for this use is met. For example, if sufficient water clarity is present (i.e. "Water Clarity Acres" criterion is met), then the SWSAV designated use is supported regardless of the presence or absence of sufficient submerged aquatic vegetation (i.e. "SAV Acres" criterion is not met). This is because there can be many non-pollutant causes for the lack of SAV acres such as lack of propagule availability, herbivory by turtles, waterfowl, etc., or habitat disruption by cow-nosed rays.

Aquatic Life Use Assessment and Listing Results

A total of 1,883 sq. miles of the Bay and tributaries is impaired for Aquatic Life Use due to oxygen, water clarity, chlorophyll, or benthic community assessment (Table 6.7-6). The Open Water Aquatic Life sub-use has the largest area of impairment and thus is the largest contributor to overall aquatic life use impairment (1,683 square miles). The second largest impaired sub-use is Deep Water Aquatic Life use (336 sq. miles).

The smallest area of designated use impairment is for Shallow Water Submerged Aquatic Vegetation (65 sq. miles). The complete area of Migratory Fish Spawning and Nursery was not assessed in 2008 due to insufficient data of lack of an approved assessment method.

Table 6.7- 6) 2008 Chesapeake Bay and Tributaries aquatic life use status for oxygen, water clarity, chlorophyll and benthic impairments (Units: Square miles)

Designated Use	Fully Supporting	Total Impaired	Naturally Impaired	Insufficient Information	Not Assessed	Size Assessed
Aquatic Life Use (ALUS)	289 (1)	1,883	0	0	0	2,172
Open Water Aquatic Life (OW-ALUS)	265	1,683	0	215	0	1,948
Deep Water Aquatic Life (2) (DW-ALUS)	12	336	0	147	0	348
Deep-Channel Seasonal Refuge (2) (DC-ALUS)	0	154	0	0	0	154
Shallow Water Submerged Aquatic Vegetation (2) (SWSAV)	56 **	65 ***	0	0	0	121 *
Migratory Fish Spawning and Nursery Aquatic Life (MSN)	0	0	0	0	342	0

1) Some portion of this mileage may be not supporting aquatic life use due to parameters other than oxygen, water clarity, chlorophyll or benthic community (e.g. chloride, pH).
2) These numbers do not correspond with sizes reported in the Executive Summary or other chapters of this report because of limitations and usage as described in this section. They are reported here for tracking changes in the sizes of these impairments between reporting periods.
* This is the sum total SAV acreage criteria for all CBP segments.
** This is the sum total of SAV acreage observed in any single best year of the most recent 3 years.
*** This is the difference between total SAV acreage criteria and the SAV acreage in any single best year of the most recent 3 years.

Table 6.7-7 presents the cause of impairment of the designated uses. The majority of impairment is due to dissolved oxygen depletion (1,859 square miles). Previous assessment reports suggested that the areas of dissolved oxygen impairment were generally limited to areas in deeper waters related to natural water column stratification. The new assessment process indicates that many areas of generally more shallow waters, relatively well mixed, or close to inputs of oxygen rich oceanic waters (i.e. areas designated with the Open Water Aquatic Life Use) also have impaired conditions for dissolved oxygen. The second largest cause for impairment is biological integrity assessments based upon analysis of the benthic macroinvertebrate community. A total of 387 sq. miles are impaired because of this. About half of the benthic community impairments are caused by low dissolved oxygen, a small area is caused by sediment contaminants, and the remainder is due to unknown causes (see previous Figure 6.7-9). The third largest cause of impairment is due to excessive levels of Chlorophyll (203 square miles). The smallest size cause of impairment is lack of sufficient Submerged Aquatic Vegetation (65 square miles). This lack of Submerged Aquatic Vegetation has been generally attributed to overall declines in water clarity throughout the Chesapeake Bay and tributaries.

Table 6.7- 7 (Units: Square miles)

Impairment Cause	Total Size
OXYGEN DEPLETION (1)	1,859
BIOLOGIC INTEGRITY (BIOASSESSMENTS)	387
CHLOROPHYLL-A	203
AQUATIC PLANTS (MACROPHYTES) (1)	65

1) These numbers may not correspond with sizes reported in the Executive Summary or other chapters of this report because of limitations and usage as described in this section. They are reported here for tracking changes in the sizes of these impairments between reporting periods.

It should be noted that the square mileage size of Deep Water Aquatic Life Use subcategory (DW-ALUS), Deep Channel Aquatic Life Use subcategory (DC-ALUS), Shallow Water Aquatic Life Use subcategory (SWSAV), and Aquatic Life Use (ALUS) in this section are different than reported in other chapters or summarized from the Assessment Data Base (ADB). This is because of the complex spatial nature of the uses and limitations of reporting capability of ADB. A few of the reasons for differences between results in this section and area calculations in other chapters or created from ADB are listed below.

- This section reports only on Aquatic Life use and sub-use impairments due to dissolved oxygen, water clarity, chlorophyll, and Chesapeake Bay Program benthic community assessments. Some waters have met all the assessed criteria for these parameters (e.g. RPPOH) but remain impaired in ADB for Aquatic Life due to other parameters (e.g. pH, chloride, bacteria, toxics, etc.). ALUS impairments due to these other parameters are not reported in this section.

- The area of DW-ALUS and DC-ALUS reported in ADB is larger than the actual size as reported in this section. The area of these uses reported in this section is the actual size as calculated from locations of the pycnocline and this area is smaller than the whole assessment unit. However, DW-ALUS and DC-ALUS area in ADB can only be reported as being present throughout the whole assessment unit.

- The area of SWSAV use reported in ADB is larger than the actual size as reported in this section. The SWSAV designated use exists only within the area defined by the SAV acres criteria. For example, CBP Segment CB8PH has an SAV acres criterion of 11 acres (see table 6.7-2) and therefore the area of SWSAV designated use for this segment is 11 acres (0.02 square miles). However, within ADB the size of SWSAV use can only be reported as the whole area of the assessment unit (i.e. 48.4 square miles for CB8PH). In summary for this example segment (CB8PH), ADB contains an area impaired for SWSAV use of 48.4 square miles but the area as more accurately reported in this section is only .02 square miles.

- The area of impairment for Aquatic Life use (ALUS) within ADB can be incorrect due to incorporation of Aquatic Life sub-uses. For example, segment CB8PH failed SWSAV use so the segment also fails the ALUS use. The area of SWSAV use within this segment is only 11 acres (.02 square miles) so the area of ALUS impairment due to the SWSAV sub-use is only .02 square miles. However, within ADB the area of ALUS can only be reported as the complete area of the assessment unit (48.4 square miles). In summary for this example, ADB reports an area impaired for ALUS of 48.4 square miles but the area as more accurately reported in this section is only .02 square miles.

Table 6.7-8 shows the designated uses, detailed criteria assessment results and listing category for each CBP program segment.

Table 6.7-8) Data assessment results and assessment determination by CBP segment and designated use.

Legend

Data Assessment Results

Cell Shading	Analysis Result
	Criteria Not Applicable
	Criteria Not Assessed
	Insufficient Data or lack of approved methods to assess criteria
	Attainment of Criteria
	Non-Attainment of Criteria

Use Assessment Category	Description
2A	Waters are supporting all of the uses for which they are monitored.
3B	Some data exists but is insufficient to determine attainment of designated uses.
5A	The water quality standard is not attained. The AU is impaired for one or more designated uses by a pollutant(s) and requires a TMDL (303d list).

Miscellaneous

ALUS RESULT: The assessment determination for Aquatic Life Use in this row includes benthos criterion assessment result, plus impairments for the aquatic life use subcategories within the segment, plus the “worst case” use assessment category from aquatic life use subcategories within the segment.

MSN: Migratory Spawning and Nursery Aquatic Life Use Subcategory.

OW: Open Water Aquatic Life Use Subcategory.

DW: Deep Water Aquatic Life Use Subcategory.

SWSAV: Shallow Water Aquatic Life Use Subcategory.

Spring: Spring Time assessment period. For chlorophyll criterion this is March through May. For MSN dissolved oxygen criteria this is February through May.

Summer: Summer Time assessment period. For dissolved oxygen this is June - September. For Chlorophyll this is July - September.

ROY: Non-Summer "Rest of Year" assessment period. For dissolved oxygen this is Oct. - May. For Chlorophyll this is March-May.

30D: 30- Day Dissolved Oxygen Criterion.

7D: 7- Day Dissolved Oxygen Criterion.

1D: 1 Day Mean Dissolved Oxygen Criterion.

IM: Instantaneous Minimum Dissolved Oxygen Criterion.

SAV: Submerged Aquatic Vegetation.

WC: Water Clarity.

Chl: Numeric Chlorophyll Criterion. Numeric Chlorophyll criterion is applicable only to James River. Narrative criterion applies to remaining Bay and Tidal Tributaries.

		Data Assessment Results Presented by Subcategory									**Assessment Determination**		
		Dissolved Oxygen					SAV						
Bay Segment	Designated Use	Time Period	30D	7D	1D	IM	SAV Acres	WC Acres	Chl	Benthos (1)	Assessment Decision	Impairments (1)	Use Assessment Category
APPTF	**ALUS RESULT**										**Fails**	**Aquatic Vegetation**	**5A**
APPTF	MSN	Spring									Insufficient Data		3B
APPTF	OW	ROY									Meets		2A
		Summer											
APPTF	SWSAV										Fails	Aquatic Vegetation	5A

		Data Assessment Results Presented by Subcategory									Assessment Determination		
		Dissolved Oxygen					SAV						
Bay Segment	Designated Use	Time Period	30D	7D	1D	IM	SAV Acres	WC Acres	Chl	Benthos (1)	Assessment Decision	Impairments (1)	Use Assessment Category
CB5MH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen, Benthic Community**	**5A**
CB5MH	DC	Summer									Fails	Dissolved Oxygen	5A
CB5MH	DW	Summer									Fails	Dissolved Oxygen	5A
CB5MH	OW	ROY									Insufficient Data - Previously Listed		3B (4)
		Summer											
CB5MH	SWSAV										Fails	Aquatic Vegetation	5A
CB6PH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen**	**5A**
CB6PH	DW	Summer									Fails	Dissolved Oxygen	5A
CB6PH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
CB6PH	SWSAV										Fails	Aquatic Vegetation	5A
CB7PH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen**	**5A**
CB7PH	DW	Summer									Insufficient Data - Previously Listed		3B
CB7PH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
CB7PH	SWSAV										Fails	Aquatic Vegetation	5A
CB8PH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation**	**5A**
CB8PH	OW	ROY									Meets		2A (3)
		Summer											
CB8PH	SWSAV										Fails	Aquatic Vegetation	5A
CHKOH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen**	**5A**
CHKOH	MSN	Spring									Insufficient Data		3B
CHKOH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
CHKOH	SWSAV										Meets		2A
CRRMH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen, Aquatic Vegetation**	**5A**
CRRMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
CRRMH	SWSAV										Fails	Aquatic Vegetation	5A
EBEMH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen, Benthic Community**	**5A**
EBEMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
ELIPH	ALUS RESULT										Fails	Dissolved Oxygen	5A
ELIPH	OW	ROY									Fails	Dissolved Oxygen	5A

		Data Assessment Results Presented by Subcategory									Assessment Determination		
		Dissolved Oxygen					SAV						
Bay Segment	Designated Use	Time Period	30D	7D	1D	IM	SAV Acres	WC Acres	Chl	Benthos (1)	Assessment Decision	Impairments (1)	Use Assessment Category
		Summer											
JMSMH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen, Chlorophyll-a**	**5A**
JMSMH	MSN	Spring									Insufficient Data		3B
JMSMH	OW	ROY									Fails	Dissolved Oxygen, Chlorophyll-a	5A
		Summer											
JMSMH	SWSAV										Meets		2A
JMSOH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen, Benthic Community, Chlorophyll-a**	**5A**
JMSOH	MSN	Spring									Insufficient Data		3B
JMSOH	OW	ROY									Fails	Dissolved Oxygen, Chlorophyll-a	5A
		Summer											
JMSOH	SWSAV										Fails	Aquatic Vegetation	5A
JMSPH	**ALUS RESULT**										**Fails**	**Chlorophyll-a, Nutrients Overlist**	**5A**
JMSPH	OW	ROY									Fails	Chlorophyll-a	5A
		Summer											
JMSPH	SWSAV										Meets		2A
JMSTF1 - Lower	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen, Chlorophyll-a, Nutrients Overlist**	**5A**
JMSTF1 - Lower	MSN	Spring									Insufficient Data		3B
JMSTF1 - Lower	OW	ROY									Fails	Dissolved Oxygen, Chlorophyll-a	5A
		Summer											
JMSTF1 - Lower	SWSAV										Fails	Aquatic Vegetation	5A
JMSTF2 - Upper	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Chlorophyll-a, Nutrients Overlist**	**5A**
JMSTF2 - Upper	MSN	Spring									Insufficient Data		3B
JMSTF2 - Upper	OW	ROY									Fails	Chlorophyll-a	5A
		Summer											
JMSTF2 - Upper	SWSAV										Fails	Aquatic Vegetation	5A
LAFMH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen**	**5A**
LAFMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
LYNPH	ALUS RESULT										Fails	Aquatic Vegetation, Benthic Community, Dissolved Oxygen	5A
LYNPH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											

		Data Assessment Results Presented by Subcategory									Assessment Determination		
		Dissolved Oxygen					SAV						
Bay Segment	Designated Use	Time Period	30D	7D	1D	IM	SAV Acres	WC Acres	Chl	Benthos (1)	Assessment Decision	Impairments (1)	Use Assessment Category
LYNPH	SWSAV										Fails	Aquatic Vegetation	5A
MOBPH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen**	**5A**
MOBPH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer									Fails		
MOBPH	SWSAV										Fails	Aquatic Vegetation	5A
MPNOH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen, Benthic Community**	**5A**
MPNOH	MSN	Spring									Insufficient Data		3B
MPNOH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
MPNTF	**ALUS RESULT**										**Fails**	**Previous "Nutrient" OverList**	**5A (2)**
MPNTF	MSN	Spring									Insufficient Data		3B
MPNTF	OW	ROY									Insufficient Data - Previously Listed		3B (4)
		Summer											
MPNTF	SWSAV										Meets		2A
PIAMH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen, Aquatic Vegetation**	**5A**
PIAMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
PIAMH	SWSAV										Fails	Aquatic Vegetation	5A
PMKOH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen**	**5A**
PMKOH	MSN	Spring									Insufficient Data		3B
PMKOH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
PMKTF	**ALUS RESULT**										**Fails**	**Previous "Nutrient" OverList**	**5A (2)**
PMKTF	MSN	Spring									Insufficient Data		3B
PMKTF	OW	ROY									Insufficient Data - Previously Listed		3B (4)
		Summer											
PMKTF	SWSAV										Meets		2A
POCMH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation**	**5A**
POCMH	OW	ROY									Meets		2A (3)
		Summer											
POCMH	SWSAV										Fails	Aquatic Vegetation	5A
POCOH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen**	**5A**
POCOH	MSN	Spring									Insufficient Data		3B
POCOH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
POTMH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen**	**5A**

		Data Assessment Results Presented by Subcategory									Assessment Determination		
		Dissolved Oxygen					SAV						
Bay Segment	Designated Use	Time Period	30D	7D	1D	IM	SAV Acres	WC Acres	Chl	Benthos (1)	Assessment Decision	Impairments (1)	Use Assessment Category
POTMH	DC	Summer									Not Assessed		3B
POTMH	DW	Summer									Meets		2A (3)
POTMH	MSN	Spring									Insufficient Data		3B
POTMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
POTMH	SWSAV										Fails	Aquatic Vegetation	5A
POTOH	**ALUS RESULT**										**Meets**		**2A (3)**
POTOH	MSN	Spring									Insufficient Data		3B
POTOH	OW	ROY									Meets		2A (3)
		Summer											
POTOH	SWSAV										Meets		2A
POTTF	**ALUS RESULT**										**Meets**		**2A (3)**
POTTF	MSN	Spring									Insufficient Data		3B
POTTF	OW	ROY									Meets		2A (3)
		Summer											
POTTF	SWSAV										Meets		2A
RPPMH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen, Benthic Community**	**5A**
RPPMH	DC	Summer									Fails	Dissolved Oxygen	5A
RPPMH	DW	Summer									Fails	Dissolved Oxygen	5A
RPPMH	MSN										Insufficient Data		3B
RPPMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
RPPMH	SWSAV										Fails	Aquatic Vegetation	5A
RPPOH	**ALUS RESULT**										**Meets**		**2A (3)**
RPPOH	MSN	Spring									Insufficient Data		3B
RPPOH	OW	ROY									Meets		2A (3)
		Summer											
RPPOH	SWSAV										Meets		2A
RPPTF	**ALUS RESULT**										**Fails**	**Dissolved Oxygen**	**5A**
RPPTF	MSN	Spring									Insufficient Data		3B
RPPTF	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
RPPTF	SWSAV										Meets		2A
SBEMH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen**	**5A**
SBEMH	DW	Summer									Fails	Dissolved Oxygen	5A
SBEMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											

Bay Segment	Designated Use	Time Period	30D	7D	1D	IM	SAV Acres	WC Acres	Chl	Benthos (1)	Assessment Decision	Impairments (1)	Use Assessment Category
		Data Assessment Results Presented by Subcategory: Dissolved Oxygen					SAV				Assessment Determination		
TANMH	**ALUS RESULT**										**Fails**	**Aquatic Vegetation, Dissolved Oxygen**	**5A**
TANMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
TANMH	SWSAV										Fails	Aquatic Vegetation	5A
WBEMH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen**	**5A**
WBEMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
YRKMH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen, Aquatic Vegetation**	**5A**
YRKMH	MSN	Spring									Insufficient Data		3B
YRKMH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
YRKMH	SWSAV										Fails	Aquatic Vegetation	5A
YRKPH	**ALUS RESULT**										**Fails**	**Dissolved Oxygen, Aquatic Vegetation**	**5A**
YRKPH	DW	Summer									Fails	Dissolved Oxygen	5A
YRKPH	OW	ROY									Fails	Dissolved Oxygen	5A
		Summer											
YRKPH	SWSAV										Fails	Aquatic Vegetation	5A

1) Benthic community assessment and impairment in this table are for mainstem assessment unit portion of these CBP segments only. Tributaries to these segments are assessed as separate assessment units and may have differing benthic community assessment or impairment as shown in the Benthic Assessment Results section of this chapter. ALUS use category assignations based on these benthic assessments also applies only to the mainstem portion of these CBP segments.

2) This ALUS category 5A applies only to the assessment units within this CBP segment which were impaired for dissolved oxygen prior to 2006 due to EPA overlisting or D.O. standard violations. Category 3B should be assigned to assessment units which were first listed for D.O. impairment in 2006. This generally applies if it is an overlisted segment (i.e. all but Potomac, RPPTF, and RPPOH) now meeting assessed DO criteria but some DO criteria are still not assessed. This serves to carry-forward pre-2006 DO listings until all DO criteria have been assessed.

3) This ALUS, OW, DW, DC category 2A applies only to assessment units within this CBP segment which were first listed for Bay criteria impairments in 2006 or never listed as impaired previously. Category 3B should be assigned to assessment units which were impaired for dissolved oxygen prior to 2006 due to EPA overlisting or D.O. standard violations until all applicable dissolved oxygen criteria have been assessed and attained. This footnote applies if it is NOT an overlisted segment and now meets assessed DO criteria (i.e. is all Potomac, RPPTF, POCMH, and RPPOH).

4) This OW category 3B applies only to assessment units within this CBP segment which were impaired for dissolved oxygen prior to 2006 due to EPA overlisting or D.O. standard violations (i.e. Mainstem Chesapeake Bay, Mattaponi, Pamunkey, York, James, Elizabeth R. and Braches). These mainstem Bay assessment units shall remain as insufficient data until all DO criteria are assessed. Category 2A will be assigned to assessment units within this CBP segment which have not been previously listed for dissolved oxygen impairment.

Future Assessment Refinements

This is the second report to present assessment of the recently developed designated uses in the Chesapeake Bay and its tidal tributaries. Much progress has been made in developing realistic and appropriate designated uses, associated criteria, and assessment protocols for the Chesapeake Bay and its tidal tributaries. Continued refinement for future assessments is summarized below. To assure consistency throughout the multi-State Chesapeake Bay system, most of these issues will be resolved through the Water Quality Criteria Assessment Workgroup involving EPA Region III, EPA Chesapeake Bay Program, Maryland Department of the Environment, Maryland Department of Natural Resources and the Virginia Department of Environmental Quality.

- *Assessment of currently un-assessed designated uses and criteria.*

Of the five new aquatic life sub-uses, this assessment reports only on conditions for “Open Water Aquatic Life”, “Deep Water Aquatic Life”, “Deep Channel Aquatic Life” and “Shallow Water Submerged Aquatic Vegetation” aquatic life uses. It is anticipated that future reports will assess the remaining aquatic life sub-use of “Migratory and Spawning Fish”. Also, only a limited suite of dissolved oxygen criteria for each sub-use were assessed, these being 30-Day average dissolved oxygen and instantaneous minimum (Deep Channel use was the only one assesses for instantaneous minimum). The other three dissolved oxygen criteria were not assessed (e.g. 7-day, 1-day, and instantaneous minimum criteria for dissolved oxygen). These limitations on assessments of designated uses and criteria are due to the lack of available data as well as the needs to finalize data assessment protocols.

- *Refinements to assessment protocols*

While DEQ believes the protocols performed for his assessment are valid, the following issues may be examined in more detail for future assessments:

a. Refinements in spatial interpolation methods.

Part of the assessment protocol involves spatial interpolation of data to create a 3-dimensional depiction of oxygen conditions throughout a waterbody segment. The software used for performing this step in this assessment may be refined and updated to enhance interpolation for future assessments.

b. Refinements in statistical determination of attainment.

Data are assessed after interpolation for criteria exceedences using a reference curve to determine waterbody attainment. The assessment was based on either EPA published reference curves or used a default 10% reference curve if a published one was not available for a specific aquatic life subcategory (e.g. deep water). It is possible that new reference curves developed by EPA could be adopted into Virginia Water Quality and used in future assessments. Also, there may be future efforts to explicitly incorporate statistical measures of uncertainty into the reference curve attainment process.

- *Refinement to EPA’s assessment data base (ADB)*

DEQ will attempt to work with EPA for modifications to the ADB so that accurate reporting of areas for each aquatic life subcategory can be performed within the ADB system.